Annual Book Issue

SCIENCE

26 April 1957

Volume 125, Number 3252

Editorial About Books 785

Articles Literature, Science, and the Manpower Crisis: *J. Gallant* 787

Science, Censorship, and the Public Interest: *G. Piel* 792

Abbreviations: *R. V. Ormes* 794

Scientific Approach to Ethics: *A. Rapoport* 796

Classifying and Indexing for the Special Library: *S. Herner* and *R. S. Meyer* 799

Science, Imagination, and Art: *N. R. Campbell* 803

Natural and Cultural Aspects of Floods: *P. B. Sears* 806

News of Science News Articles and Briefs; Scientists in the News; Recent Deaths 808

Book Reviews General 813

Biology and Medicine 815

History and Philosophy of Science 821

Physical Sciences 824

Social Sciences 830

New Books 833

Index of Books Reviewed in *Science*, 27 April 1956 through 19 April 1957 .. 834

Forthcoming Events 850

Letters 852

Equipment News 855

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Paper electrophoresis takes 2 important steps

Spinco announces developments which make the Model R Paper Electrophoresis System more useful than ever for such analyses as serum proteins, lipoproteins, glycoproteins, amino acids, carbohydrates, hemoglobins, proteins in spinal fluid, tears, and in other body fluids, enzymes, extracts, and a number of other inorganic and organic mixtures.

1

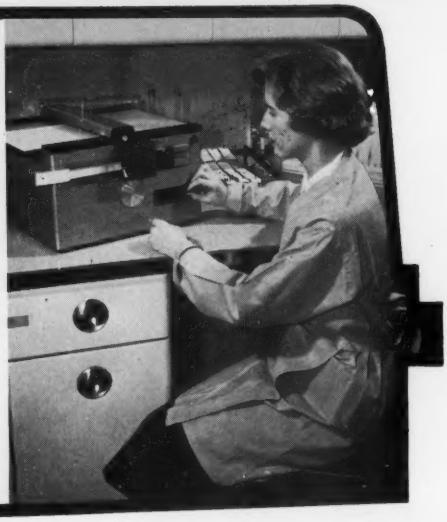
NEW PROCEDURE

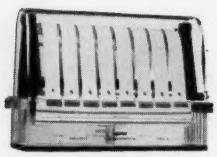
Improved low-noise paper plus several changes in recommended procedure increase accuracy and reproducibility. Subtler changes in the distribution of electrophoretic components can now be recognized with certainty. In addition, for serum proteins, analysis time has been reduced by over five hours through a new dyeing technique.

2

NEW ANALYTROL

The Spinco Analytrol recording scanner and integrator, which quantitates the paper strips, now uses narrow bandpass filters and a high-sensitivity servo amplifier. This substantially improves reproducibility and makes the Analytrol a general-purpose paper scanner, recording colorimeter and recording densitometer.





PRESENT USERS can bring existing Model R Systems up-to-date by converting earlier-model Analytrols and taking advantage of the new procedure.

FOR A FLOW CHART of the new serum protein method and for more information on the new Spinco Model R Paper Electrophoresis System write to Spinco Division, Beckman Instruments, Inc., Stanford Industrial Park, Palo Alto, California, Ask for Data File R5.

Beckman® / Spinco Division

Looking for a Particular Classroom Text or Reference Book? You May Find it Here

Handbook of Biological Data

New!

A *new publication* in the field of biology, this monumental work contains a multitude of standard values, organized into 445 tables. You'll find data on an amazing variety of subjects. The general areas are: General biophysics and biochemistry; tissue characteristics; the cell; fertilization; reproduction; growth; nutrition; metabolism; ecology; pathology. This is truly one of the most valuable references a biologist can have. It is as useful as the well known "Handbook of Chemistry and Physics". Written by *4041 authorities*, this practical and informative handbook gives you a unified source of information. It will save you much time when you need to look up a particular standard value outside your specialty.

Here are just a few of the table titles: Acids and Bases: Dissociation Constants—Life Span: Pollen—Photosynthesis: Rates—Toxic Plants—Common Poisons—Growth Regulators—Diets: Zoo Animals—Effects of Acceleration: Man—Sea Water: Characteristics—*and 436 more.*

Edited by WILLIAM S. SPECTOR, Executive Secretary, The Committee on the Handbook of Biological Data. Prepared under the direction of the Committee on the Handbook of Biological Data, The National Academy of Sciences—The National Research Council. 584 pages, 8½" x 11", $7.50. *New.*

Arey – Developmental Anatomy

6th Edition

This classic text is well known for its exceptionally clear and visual presentation of embryology. Part I, General Development, explains fundamental concepts and the origin of the embryo. Part II, Special Development, discusses the differentiation of the cells into organs and systems. Both function and structure are thoroughly covered. Part III is a laboratory manual. It studies the pig and chick embryos in detail. The arrangement of the material is clear, concise and logical. All basic facts are discussed in larger type for the general college student and the more detailed and technical data are included in smaller type for medical and more advanced workers. A summary of experimental analysis entitled "Causal Relations" is given for each organ or group. 1552 outstanding illustrations make the text as clear as possible. They are well labeled and many are in color.

By LESLIE BRAINERD AREY, Ph.D., Sc.D., L.L.D., Robert Laughlin Rea Professor of Anatomy, Northwestern University. 680 pages, 6½" x 9¾", with 1552 illustrations on 630 figures, many in color. $9.50. *Sixth Edition.*

Turner – General Endocrinology

2nd Edition

Dr. Turner's clearly written and beautifully illustrated text is especially designed for advanced college courses in the biological sciences and for graduate courses. This *Second Edition* maintains the general viewpoint introduced so successfully in the First Edition—the subject is a basic biologic science which can be pursued profitably by general college students interested in biology and related fields. Every aspect of endocrinology is thoroughly explored and clearly explained. First the historical background is covered. Then Dr. Turner describes the experimental and clinical methods used in gaining knowledge; the interrelations of glandular function; and the evolution and embryology of all types of regulation in both plants and animals—auxins, organizers, neural regulators and endocrines. The chapters on the individual glands are literally packed with details of gross, microscopic, developmental and comparative anatomy; biochemistry; physiology; dysfunction; clinical manifestations, etc.

By C. DONNELL TURNER, Ph.D., Lecturer in Biology, Tokyo Army Education Center, Tokyo, Japan. 553 pages, 6" x 9", with more than 300 illustrations on 171 figures. $8.00. *Second Edition.*

Gladly Sent For Consideration as Texts

W. B. SAUNDERS COMPANY

West Washington Square, Philadelphia 5

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢.

New WILEY books for

ORGANIC REACTIONS, Volume IX

Editor-in-Chief: Roger Adams, University of Illinois. Deals with seven important new reactions and gathers together the work of ten contributors. Like its predecessors, the book gives ready access to a compilation of reliable and comprehensive information. As in the other eight volumes, the survey of each reaction includes a general discussion of method, modifications, examples of applicability, special precautions, a detailed description of procedure, yields, and other pertinent data. Coming in May. Approx. 484 pages. Prob. $12.50.

A TREATISE ON LIMNOLOGY, Vol. I

Geography, Physics, and Chemistry

By G. E. Hutchinson, Yale University. A unique treatment of the whole subject of limnology which covers (in two volumes) the geographical, physical, chemical, biological and geological aspects with equal emphasis. Lakes as earth forms are stressed, the physical and chemical environments of lake sediments are treated, and a good deal of background material on bodies of water, relative to water supply, sewage, etc., is included. Coming in August. Approx. 888 pages. Prob. $18.00.

ZOOGEOGRAPHY

The Geographical Distribution of Animals

By Philip J. Darlington, Jr., Harvard University. Outlines the principles of geographical distribution of animals over the world, stressing the importance of the tropics and treating the vertebrate faunas of South America and Australia in special detail. The factual material is presented as a complete classification and list of families of existing land and freshwater vertebrates, with distribution, pertinent fossil record, and other important facts about each family. A special discussion of the Arctic is included. Coming in July. Approx. 728 pages. Prob. $15.00.

SCIENTIFIC FRENCH

By William N. Locke, The Massachusetts Institute of Technology. Offers a quick, practical approach to the reading of contemporary technical French. No previous knowledge of the language is required. Selections and simple sentences are taken from current scientific books and journals. The author thoroughly covers the constructions that students will encounter in reading technical French. Coming in April. 112 pages. Prob. $2.25.

THE CHEMISTRY OF ORGANIC MEDICINAL PRODUCTS, 4th Ed.

By Glenn L. Jenkins, Walter H. Hartung, Kenneth E. Hamlin, Jr., and John B. Data. Gives a rational system of chemical classification for organic medicinal compounds. Includes the most recent developments in the areas of the antibiotics, tranquillizing drugs, insulin products, antihistamines, and other medicinal agents. The volume is completely revised. Correlations between chemical structure and physiological activities are pointed out, and, wherever possible, protoplasmic reactions are indicated. Coming in June. Approx. 610 pages. Prob. $10.00.

SCIENTIFIC GERMAN

By George Condoyannis, St. Peter's College. A German scientific grammar with the same purposes as those outlined above in *Scientific French*. Designed for the student who wishes to acquire a rapid and direct reading knowledge of German adequate to cope with the technical articles and books in the field. It is planned for use with unsimplified scientific reading matter in conjunction with a dictionary. Coming in April. Approx. 180 pages. Prob. $2.50.

EXPERIMENTAL DESIGNS, 2nd Ed.

William G. Cochran, The Johns Hopkins University, and Gertrude M. Cox, University of North Carolina. Revised and expanded, this new edition includes a new chapter on fractional replication of factorial experiments, as well as new material on experiments in which the factors represent quantitative variables, measured on a continuous scale. One of the Wiley Publications in Statistics, Walter A. Shewhart and S. S. Wilks, Editors. Coming in May. Approx. 464 pages. Prob. $7.50.

DAIRY BACTERIOLOGY, 4th Ed.

Bacteriology of Milk Production and Milk Products

By B. W. Hammer, Consultant, and F. J. Babel, Purdue University. The most complete text in dairy bacteriology available at the present time. Revised throughout, it includes general material useful in a beginning course. A number of chapters are of primary interest to dairy manufacturing students as they cover the bacteriology of dairy products. Coming in August. Approx. 656 pages. Prob. $9.00.

JOHN WILEY & SONS, Inc.

spring and summer, 1957

A GUIDE TO THE LITERATURE OF CHEMISTRY, 2nd Ed.

By E. J. Crane, Chemical Abstracts Service, the late Austin M. Patterson, and Eleanor B. Marr, Hunter College. The most comprehensive reference work in the field. Contains the most frequently needed information on the chemical literature, tells how and where to find less frequently needed information, shows how to keep up to date on the literature, and gives data about mechanical aids for searching and indexing the chemical literature. Coming in April. 397 pages. Prob. $9.00.

PHYSICAL SCIENCE FOR LIBERAL ARTS STUDENTS

By Hugo N. Swenson and J. Edmund Woods, both of Queens College. Describes the special methods and procedures that have been found useful and effective in the natural sciences. The text answers the question: "What is science and how do the natural sciences differ from other intellectual fields?" The authors analyze the roles played by experiment, hypotheses, theories, and models. With emphasis on a historical perspective, the book outlines experimental methods of science through an examination of astronomy, chemistry, and physics. Coming in April. 333 pages. Prob. $6.50.

SOLVENT EXTRACTION IN ANALYTICAL CHEMISTRY

By George H. Morrison, Sylvania Electric Products, Inc., and Henry Freiser, University of Pittsburgh. The first comprehensive treatment of the field of solvent extraction procedures. An integrated treatment of theory and practice is offered and the systems utilized in solvent extraction are covered extensively. Aspects such as formation of metal complexes, distribution of extractable species, and chemical interactions in the organic phase are dealt with in detail. Apparatus and techniques are also covered. Coming in July. Approx. 266 pages. Prob. $6.50.

SOIL-PLANT RELATIONSHIPS

By C. A. Black, Iowa State College. Emphasizes the soil as a substrate for plant growth and integrates soil properties and plant responses. Although the terminology is kept simple, advanced ideas and analyses are presented. Basic principles are thoroughly treated, but applications are referred to only in the form of examples. This procedure minimizes the geographical limitation of the subject matter. Coming in August. Approx. 364 pages. Prob. $7.00.

EXPERIMENTS IN BIOCHEMICAL RESEARCH TECHNIQUES

By Robert W. Cowgill, University of Colorado, and Arthur B. Pardee, University of California. This is the only manual that deals with techniques of modern research biochemistry in a series of organized experiments. Each experiment is organized as to principles as well as to procedures, and each includes thought-provoking questions for students. Classroom tested, these techniques serve as a valuable reference guide to procedures, to the range of application of the techniques, and to the important literature on each subject. Coming in June. In press.

PRINCIPLES OF STRATIGRAPHY

By Carl O. Dunbar and John Rodgers, both of Yale University. This book approaches stratigraphy from the point of view of principles. It illustrates these principles inductively by examples from the stratigraphic record, but is by no means simply a description of this record. The authors emphasize the interpretation of the data of stratigraphy throughout. Sedimentary petrography, sedimentation, and stratigraphy proper are dealt with in full. Coming in June. Approx. 365 pages. Prob. $10.00.

GLACIAL AND PLEISTOCENE GEOLOGY

By Richard Foster Flint, Yale University. Reflects the unprecedented advances in Pleistocene research made during recent years. The author presents a new treatment of glaciology, and up-to-date discussions of sea-floor stratigraphy, soils, frozen-ground phenomena, and geochemical contributions to chronology and the measurement of temperatures. A great deal of new stratigraphic information has been assembled in the form of correlation charts. Coming in April. 553 pages. Prob. $15.00.

QUANTITATIVE ORGANIC ANALYSIS

By James S. Fritz and George S. Hammond, both of Iowa State College. Organized according to the major techniques of quantitative organic analysis, such as direct and indirect acid-base methods, oxidation-reduction methods, etc. Explains the principles involved and discusses the merits of the various approaches. To illustrate the application of these principles, generous use is made of specific analytical procedures and examples from the authors' own experience. Comprehensive, up-to-date discussions of theory and scope of non-aqueous acid-base titrations are included. Coming in June. Approx. 286 pages. Prob. $6.00.

Send for examination copies.

440 Fourth Avenue New York 16, N.Y.

NOW...

you can make

MOISTURE TESTS IN MINUTES

with the fully automatic

IR MOISTURE -MATIC BALANCE

Tests anything that can be oven-dried... just load... set time and heat... and let the instrument do the rest.

ALL the operator has to do is load the pan and set the timer and heat control to get quick, accurate, permanently recorded moisture readings of granular solids, pastes, liquids, waxes or anything else that can be dried by heat.

The portable IR Moisture-Matic, a product of Moore-Milford Corporation, utilizes *far* infrared for highest absorption and rapid, even heating, and has both a self-contained timer and variable heat control between 30 and 600 watts. The motor driven torsion balance automatically weighs the sample after the test, and the moisture percent is retained on a 3 digit counter to the nearest 0.1 percent. Operates on 115-volts, 60 cycles AC.

All components are of instrument quality to assure long life without maintenance expense. For guaranteed accuracy and speed in your moisture testing, ask your Scientific Products representative for a demonstration or write us today.

IR Moisture-Matic Balance complete, ready for use...

$295.00

S/P

Scientific Products—a single source for all laboratory supplies and equipment—offers a complete selection of moisture testers for every application.

Scientific Products

DIVISION OF AMERICAN HOSPITAL SUPPLY CORPORATION

New York • Chicago • Kansas City • Minneapolis • Atlanta • Washington • Dallas
Los Angeles • San Francisco

Leitz **first in precision optics**

LEITZ PHASE CONTRAST OBJECTIVES

15456

The complete line of LEITZ PHASE CONTRAST OBJECTIVES makes possible a wide range of magnifications and working distances in phase contrast microscopy. Manufactured to the highest standards known to optical science, LEITZ PHASE CONTRAST OBJECTIVES include water and oil immersion types as well as high dry objectives with exceptionally long working distances. The latter, available with high contrast, are particularly desirable for tissue culture examinations.

The LEITZ PHASE CONTRAST CONDENSER, when used with high dry objectives, has a working distance of approximately 12 millimeters—one example of the many advantages of LEITZ PHASE CONTRAST.

A reputation for integrity and a tradition of service have led thousands of scientific workers to bring their optical problems to Leitz. If you have problems in this field, why not let us help you with them?

See your Leitz dealer and examine these Leitz instruments soon. Write for information.

E. LEITZ, INC., Dept. SC-4
468 Fourth Avenue, New York 16, N.Y.

Please send me the Leitz _____ brochure.

NAME _____

STREET _____

CITY _____ ZONE _____ STATE _____

E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N.Y.
Distributors of the world-famous products of
Ernst Leitz G. m. b. H., Wetzlar Germany – Ernst Leitz Canada Ltd.
LEICA CAMERAS • LENSES • MICROSCOPES • BINOCULARS

I. R. MAXWELL & CO LTD

Second-hand and Out-of-Print Department

SCIENTISTS AND LIBRARIANS

Please check this list of periodicals against your library. We urgently require these to fill orders to university and industrial libraries at home and abroad. We will pay highest market prices and be most grateful for any you can offer. Please send us a list of your holdings of learned books and periodicals that you are willing to sell. We shall also be glad to receive a list of your wants of out-of-print books and journals to check against our very extensive stocks. We will send our quotations by return.

AERONAUTICAL ENGINEERING REVIEW: Vols. 1–14.
AMERICAN ANTHROPOLOGIST:
New Series: Vols. 1–58.
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS. BULLETIN: Vols. 1–40.
AMERICAN CHEMICAL SOCIETY JOURNAL: Vols. 1–78.
AMERICAN ENTOMOLOGICAL SOCIETY. TRANSACTIONS: Vols. 1–82.
AMERICAN GEOPHYSICAL UNION. TRANSACTIONS: Vols. 1–36.
AMERICAN JOURNAL OF ANATOMY: Vols. 1–98.
AMERICAN JOURNAL OF BOTANY: Vols. 1–42.
AMERICAN JOURNAL OF CLINICAL PATHOLOGY: Vols. 1–24.
AMERICAN JOURNAL OF HUMAN GENETICS: Vols. 1–8.
AMERICAN JOURNAL OF HYGIENE: Vols. 1–61.
AMERICAN JOURNAL OF MATHEMATICS: Vols. 1–78.
AMERICAN JOURNAL OF PATHOLOGY: Vols. 1–32.
AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY: New Series: Vols. 1–14.
AMERICAN JOURNAL OF PHYSICS: Vols. 1–23.
AMERICAN JOURNAL OF PHYSIOLOGY: Vols. 1–181.
AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY: Vols. 1–71.
AMERICAN JOURNAL OF SCIENCE: Vols. 1–254.
AMERICAN JOURNAL OF TROPICAL MEDICINE AND HYGIENE: Vols. 1–5.
AMERICAN MATHEMATICAL MONTHLY: Vols. 1–62.
AMERICAN MATHEMATICAL SOCIETY. BULLETIN: Vols. 1–61.
AMERICAN MATHEMATICAL SOCIETY.
PROCEEDINGS: Vols. 1–6.
TRANSACTIONS: Vols. 1–78.
AMERICAN METEOROLOGICAL SOCIETY. BULLETIN: Vols. 1–36.
AMERICAN MICROSCOPICAL SOCIETY. TRANSACTIONS: Vols. 1–75.
AMERIAN PSYCHOLOGIST: Vols. 1–11.
AMERICAN ROCKET SOCIETY. JOURNAL: Vols. 1–86.
AMERICAN SOCIETY FOR TESTING MATERIALS. PROCEEDINGS: Vols. 1–54.
AMERICAN SOCIETY OF CIVIL ENGINEERS. PROCEEDINGS: Vols. 1–81.
ANALYTICAL CHEMISTRY. (Formerly Industrial and Engineering Chemistry: Analytical Edition): Vols. 1–28.
ANATOMICAL RECORD: Vols. 1–124.
ANNALS OF MATHEMATICAL STATISTICS: Vols. 1–26.
ANNALS OF MATHEMATICS: Series 2: Vols. 1–61.
APPLIED MICROBIOLOGY: Vols. 1–4.
APPLIED SPECTROSCOPY: Vols. 1–9.
ASTRONOMICAL JOURNAL: Vols. 1–61.
ASTROPHYSICAL JOURNAL: Vols. 1–121.
ATOMIC ENERGY NEWSLETTERS: Vols. 1–8.
BACTERIOLOGICAL REVIEWS: Vols. 1–19.
BIOLOGICAL ABSTRACTS: Vols. 1–29.
BIOLOGICAL BULLETIN: Vols. 1–108.
BOTANICAL GAZETTE: Vols. 1–116.
BOTANICAL REVIEW: Vols. 1–21.
CHEMICAL ABSTRACTS: Vols. 1–50.
CHEMICAL AND ENGINEERING NEWS: Vols. 1–33.
CHEMICAL ENGINEERING:
(Formerly Chemical and Metallurgical Engineering). Vols. 1–63.
CHEMICAL ENGINEERING PROGRESS: Vols. 1–51.
CHEMICAL REVIEWS: Vols. 1–55.
CIRCULATION: Vols. 1–13.
CORROSION: Vols. 1–11.
ECONOMIC GEOLOGY:
(Formerly AMERICAN GEOLOGIST). Vols. 1–51.
ENTOMOLOGICAL SOCIETY OF AMERICA. ANNALS: Vols. 1–48.
EXPERIMENTAL CELL RESEARCH: Vols. 1–10.
EXPERIMENTAL PARASITOLOGY: Vols. 1–5.
GENETICS: Vols. 1–55.
GEOGRAPHICAL REVIEW: Vols. 1–44.
GEOLOGICAL SOCIETY OF AMERICA. BULLETIN: Vols. 1–66.
HUMAN BIOLOGY: Vols. 1–27.
INDUSTRIAL AND ENGINEERING CHEMISTRY: (INDUSTRIAL EDITION). Vols. 1–48.
JOURNAL OF ABNORMAL AND SOCIAL PSYCHOLOGY: Vols. 1–51.
JOURNAL OF ALLERGY: Vols. 1–26.

Offers for single volumes or issues as well as complete or part sets welcomed.

I. R. MAXWELL & CO LTD International University and Industrial Booksellers

JOURNAL OF APPLIED MECHANICS: Vols. 1–23.
JOURNAL OF APPLIED PHYSICS: Vols. 1–26.
JOURNAL OF APPLIED PSYCHOLOGY: Vols. 1–40.
JOURNAL OF BACTERIOLOGY: Vols. 1–68.
JOURNAL OF BIOLOGICAL CHEMISTRY: Vols. 1–216.
JOURNAL OF CHEMICAL PHYSICS: Vols. 1–23.
JOURNAL OF CLINICAL ENDOCRINOLOGY: Vols. 1–18.
JOURNAL OF CLINICAL INVESTIGATION: Vols. 1–34.
JOURNAL OF COMPARATIVE AND PHYSIOLOGICAL PSYCHOLOGY: Vols. 1–49.
JOURNAL OF COLLOID SCIENCE: Vols. 1–10.
JOURNAL OF EXPERIMENTAL PSYCHOLOGY: Vols. 1–49.
JOURNAL OF GEOPHYSICAL RESEARCH: Vols. 1–60.
JOURNAL OF IMMUNOLOGY: Vols. 1–75.
JOURNAL OF INDUSTRIAL HYGIENE AND TOXICOLOGY: Vols. 1–35.
JOURNAL OF MATHEMATICS AND PHYSICS: Vols. 1–35.
JOURNAL OF METEOROLOGY: Vols. 1–12.
JOURNAL OF MORPHOLOGY: Vols. 1–96.
JOURNAL OF NEUROPHYSIOLOGY: Vols. 1–18.
JOURNAL OF ORGANIC CHEMISTRY: Vols. 1–20.
JOURNAL OF PARASITOLOGY: Vols. 1–41.
JOURNAL OF PEDIATRICS: Vols. 1–47.
JOURNAL OF PHYSICAL CHEMISTRY: Vols. 1–60.
JOURNAL OF POLYMER SCIENCE: Vols. 1–18.
JOURNAL OF THE AERONAUTICAL SCIENCES: Vols. 1–22.
MATHEMATICAL REVIEWS: Vols. 1–16.
MICHIGAN MATHEMATICAL JOURNAL: Vols. 1–3.
NUCLEAR SCIENCE ABSTRACTS: Vols. 1–10.
NUCLEONICS: Vols. 1–14.
OPTICAL SOCIETY OF AMERICA JOURNAL: Vols. 1–45.
PHARMACOLOGICAL REVIEWS: Vols. 1–8.
PHYSICAL CHEMISTRY: Vols. 1–4.
PHYSICAL REVIEW: Ser. 1: Vols. 1–35. Ser. 2: Vols. 1–94.
PHYSIOLOGICAL REVIEWS: Vols. 1–36.
PHYSIOLOGICAL ZOOLOGY: Vols. 1–29.
PHYTOPATHOLOGY: Vols. 1–46.
PLANT PHYSIOLOGY: Vols. 1–30.
POWDER METALLURGY BULLETIN: Vols. 1–10.
PSYCHOLOGICAL ABSTRACTS: Vols. 1–29.
PSYCHOLOGICAL BULLETIN: Vols. 1–52.
PSYCHOLOGICAL REVIEW: Vols. 1–63.
RADIATION RESEARCH: Vols. 1–4.
REVIEW OF METAPHYSICS: Vols. 1–9.
REVIEW OF MODERN PHYSICS: Vols. 1–28.
REVIEW OF SCIENTIFIC INSTRUMENTS: Vols. 1–27.
RUBBER CHEMISTRY AND TECHNOLOGY: Vols. 1–28.
SCIENCE: Vols. 1–120.
SOIL SCIENCE: Vols. 1–79.
TORREY BOTANICAL CLUB. BULLETIN: Vols. 1–84.
VITAMIN ABSTRACTS: Vols. 1–8.

Offers for single volumes or issues as well as complete or part sets welcomed.

Maxwell and Co. are the world's leading specialist booksellers aiding progress in science, medicine, industry and education. We offer the individual book buyer and professional librarian many up-to-date services, hitherto not available anywhere. Following are the service departments at your disposal:—

New Book Department
Subscription to Periodicals and Serials Department
Out of Print and Difficult to Get Department
Micro films and micro cards Department
Technical Translating Department
Technical Writing Department
Information Department
Bookbinding Department
Library Valuation Department

For full details of services offered, please write to the address convenient for this free descriptive booklet.

I. R. MAXWELL & CO LTD ***International University and Industrial Booksellers***

NEW YORK
122 East 55th Street, New York 22, N.Y.

LONDON
4 & 5 FITZROY SQUARE, LONDON, W.1.

PARIS
24 Rue des Ecoles, Paris V^e^.

LEA & FEBIGER SCIENTIFIC PUBLICATIONS

PATHOLOGY

SIMMONS AND GENTZKOW—MEDICAL AND PUBLIC HEALTH LABORATORY METHODS. *6th edition.* 35 contributors. 1191 pages, 115 illus. and 9 plates in color. 129 tables. $18.50

BOYD—INTRODUCTION TO MEDICAL SCIENCE. *4th edition.* 304 pages. 124 illus. and 3 plates in color. $4.50

BOYD—TEXTBOOK OF PATHOLOGY. *6th edition.* 1024 pages. 570 illustrations and 32 plates in color. $12.50

HERBUT—PATHOLOGY. 1227 pages. 7″ x 10″. 1378 illustrations on 651 figures and 6 plates in color. $16.00

LEVINSON and MacFATE—CLINICAL LABORATORY DIAGNOSIS. *5th edition.* 1246 pages. 244 illustrations and 13 plates, 11 in color. 142 tables. $12.50

QUICK—HEMORRHAGIC DISEASES. *New.* 420 pages. Illustrated. In press.

WINTROBE—CLINICAL HEMATOLOGY. *New 4th edition.* 1184 pages. 236 illus. and 20 plates, 18 in color. $15.00

PHYSIOLOGY

GROLLMAN—PHARMACOLOGY AND THERAPEUTICS. *2nd edition.* 866 pages. 127 illus. 36 tables. $10.00

HARDY—FLUID THERAPY. 255 pages. 77 illustrations. 8 tables. $5.50

LUCAS—ELEMENTS OF HUMAN PHYSIOLOGY. *2nd edition.* 357 pages, 158 illustrations, 2 in color. $4.75

STARLING'S HUMAN PHYSIOLOGY. *New 12th edition.* 1233 pages. 721 illustrations, some in color. $12.50

WIGGERS—PHYSIOLOGY IN HEALTH AND DISEASE. *5th edition.* 1242 pages. 280 illustrations. $10.00

MISCELLANEOUS

CLAUS—GATHERCOAL AND WIRTH PHARMACOGNOSY. *New 3rd edition.* 731 pages, 7″ x 10″. 306 illustrations and 1 plate in color. $12.50

McGRATH — NEUROLOGIC EXAMINATION OF THE DOG. 181 pages. 120 illustrations. $5.00

MORRISON AND CHENOWETH—NORMAL AND ELEMENTARY PHYSICAL DIAGNOSIS. *5th edition.* 412 pages. 208 illustrations. $5.50

SOFFER—DISEASES OF THE ENDOCRINE GLANDS. *2nd edition.* 1032 pages. 102 illustrations and 3 plates in color. 28 tables. $16.50

WOHL AND GOODHART — MODERN NUTRITION IN HEALTH AND DISEASE. 55 Contributors. 1062 pages. 80 illustrations. 127 tables. $18.50

ANATOMY

BOWEN-STONE—APPLIED ANATOMY AND KINESIOLOGY. *7th edition.* 462 pages. 261 illustrations, 18 in color. $5.50

BUCHANAN — FUNCTIONAL NEURO-ANATOMY. *2nd edition.* 323 pages. 7″ x 10″. 273 illus., 19 in color. $7.50

DI FIORE—AN ATLAS OF HUMAN HISTOLOGY. *New.* About 210 pages. 99 original color plates. 156 figures. Ready soon.

GRAY'S ANATOMY OF THE HUMAN BODY. *26th edition.* Edited by CHARLES MAYO GOSS, M.D. 1480 pages, 7″ x 10″. 1202 illustrations, mostly in color. $16.00

KUNTZ—THE AUTONOMIC NERVOUS SYSTEM. *4th edition.* 605 pages. 94 illustrations. $10.00

KUNTZ—TEXTBOOK OF NEURO-ANATOMY. *5th edition.* 524 pages. 331 illustrations. $8.00

QUIRING—THE EXTREMITIES. 117 pages. 106 illustrations. $2.75

QUIRING—THE HEAD, NECK AND TRUNK. 115 pages. 103 illustrations. $2.75

ZOOLOGY

FAUST AND RUSSELL—CRAIG AND FAUST'S CLINICAL PARASITOLOGY. *New 6th edition.* About 1000 pages. 346 illustrations and 7 plates in color. In press

FAUST—ANIMAL AGENTS AND VECTORS OF HUMAN DISEASE. 660 pages. 216 illustrations and 9 plates, 1 in color. 12 tables. $9.75

FAUST — HUMAN HELMINTHOLOGY. *3rd edition.* 744 pages. 313 illustrations. $10.00

KENDALL — MICROSCOPIC ANATOMY OF VERTEBRATES. *3rd edition.* 354 pages. 255 illustrations. $6.00

AGRICULTURE

CARD—POULTRY PRODUCTION. *8th edition.* 416 pages. 216 illustrations and 4 plates, 2 in color. $5.00

KNOTT—VEGETABLE GROWING. *5th edition.* 358 pages. 88 illustrations. $5.00

TALBERT—GENERAL HORTICULTURE. 452 pages. 129 illustrations. $4.00

TALBERT — GROWING FRUIT AND VEGETABLE CROPS. 350 pages. 72 illustrations. $4.50

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA 6, PA.

Please enter my order and send books listed below.

☐ Bill me at 30 days. ☐ Send on 90 days Teachers' Examination Plan. (10% Discount to Teachers)

NAME (print) ..... ADDRESS .....

CITY ..... ZONE ..... STATE .....

Sc. 4-26-57

International's new high-speed angle centrifuge model HT

A fully enclosed table model with speeds up to 17,000 r.p.m.*, forces up to 34,390 G* and capacity of 400 ml.

featuring

Complete Protection for the Operator . . .

Two thicknesses of heavy-gauge steel — guard bowl *plus* cabinet — protect operator from rotating head. Cover of thick plate steel is held securely with rugged hinge and lever lock.

Removable Instrument Panel for Remote Control . . .

Front panel unit, containing all instruments and controls can be removed easily from cabinet and is portable, allowing remote control operation when centrifuge is located in a cold room or chamber.

Complete Instrumentation . . .

Electric Tachometer constantly indicates true operating speed, regardless of line voltage fluctuations.

Ammeter shows current flow for acceleration control.

Automatic Timer shuts off centrifuge at selected time interval. Timer can be eliminated by cutout switch.

Autotransformer gives stepless speed control without heating.

Protective No-Voltage Relay, Pilot Light and Safety Fuse.

Unique Cooling System . . .

A specially designed air circulation system provides maximum cooling of head and bearings.

*Note: speeds are obtained at 115 volts input to centrifuge; force is effective centrifugal force figured at the maximum radius of the material being centrifuged.

Designed for Safe Operation

Centrifuge Inside — Controls Outside the Cold Room or Chamber

WRITE FOR BULLETIN E

International Equipment Co.

1284 SOLDIERS FIELD ROAD • BOSTON 35, MASSACHUSETTS

Now Complete

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY

Edited by **RAYMOND E. KIRK,** *Head, Department of Chemistry,* and **DONALD F. OTHMER,** *Head, Department of Chemical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.* Assistant Editors: **Janet D. Scott** and **Anthony Standen.**

15 VOLUMES

of approximately 960 pages each, treat the whole field of industrial chemistry and chemical engineering with special emphasis upon American industrial practice.

FULLY INDEXED

Volume 15, which just appeared, contains an Index to the entire work in 620 pages—about 50,000 entries.

"No reference library worthy of the name will be without this series. It is simply a must for the chemist and chemical engineer concerned with industrial angles of materials, methods, processes, and equipment"

—WALTER J. MURPHY in *Chemical and Engineering News*

The ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY is available at a special price of $25.00 per volume—valid only until July 1, 1957.

Keeping up to date

A supplement volume, similar in size and format to the original volumes, and devoted to subjects in which recent advances have been particularly striking, will be published in the Fall of 1957. Price, $25.00

INTERSCIENCE PUBLISHERS, INC.

250 Fifth Avenue, New York 1, N.Y.

RECENT ADVANCES IN SCIENCE
Physics and Applied Mathematics

Edited by MORRIS H. SHAMOS, *Associate Professor of Physics,* and GEORGE M. MURPHY, *Professor of Chemistry, New York University, New York, N. Y.*

1956. 396 pages, 170 illus., 23 tables. $7.50

(Published jointly with New York University Press)

GEOMETRIC ALGEBRA

By E. ARTIN, *Princeton University, New Jersey*

1957. (Interscience Tracts in Pure and Applied Mathematics, No. 3) 224 pages, 6 illus. $6.00

WATER WAVES

By J. J. STOKER, *Institute of Mathematical Sciences, New York University, N.Y.*

1957. (Pure and Applied Mathematics, Vol. IV) Approx. 600 pages, 192 illus., 7 tables. Approx. $16.00

PROGRESS IN LOW TEMPERATURE PHYSICS, VOLUME II

Edited by C. J. GORTER, *Professor of Physics, University of Leiden.*

1957. 485 pages, 180 illus. $10.75

THE CATHODE RAY OSCILLOSCOPE
Circuitry and Practical Applications

By J. CZECH, *Philips Electronic Application Laboratory.*

1957. 352 pages, 407 illus. $8.50

MAGNETOHYDRODYNAMICS

By T. G. COWLING, *The University, Leeds, England*

1957. (Interscience Tracts on Physics and Astronomy, No. 4) 123 pages, 17 illus.

$1.75 Paper $3.50 Hard Cover

RELAXATION SPECTROMETRY

By E. G. RICHARDSON, *Professor of Acoustics and Reader in Physics, Physics Department, King's College, University of Durham, England.*

1957. 148 pages, 89 illus. $5.75

MODERN METHODS OF MICROSCOPY

A Series of Papers Reprinted from "Research"

Edited by A. E. J. VICKERS, *Thermal Syndicate Ltd., Wallsend-on-Tyne, England.*

1956. 120 pages, 122 illus. $3.50

SEMIMICRO QUALITATIVE ORGANIC ANALYSIS

The Systematic Identification of Organic Compounds

Second edition, completely rewritten, reorganized and expanded.

By NICHOLAS D. CHERONIS, *Professor of Chemistry, Brooklyn College, Brooklyn, N.Y.* and JOHN B. ENTRIKIN, *Professor of Chemistry, Centenary College of Louisiana, Shreveport, La.*

1957. 788 pages. $9.00

ORGANIC ANALYSIS, VOLUME III

Editorial Board: JOHN MITCHELL, JR., *E. I. du Pont de Nemours & Co., Wilmington, Delaware,* I. M. KOLTHOFF, *University of Minnesota, Minneapolis, Minnesota,* E. S. PROSKAUER, *Interscience Publishers, Inc.* and A. WEISSBERGER, *Eastman Kodak Company, Rochester, N. Y.*

1956. 554 pages, 57 illus., 109 tables, including 1 color plate. $11.50

WEISSBERGER'S TECHNIQUE OF ORGANIC CHEMISTRY

Edited by A. WEISSBERGER, *Research Laboratories, Eastman Kodak Company, Rochester, N.Y.*

VOLUME II— CATALYTIC, PHOTOCHEMICAL, AND ELECTROLYTIC REACTIONS

Second Revised and Augmented Edition.

1956. 556 pages, 84 illus., 77 tables. $11.50

CATALYTIC REACTIONS by V. I. KOMAREWSKY, *Illinois Institute of Technology,* C. H. RIESZ, *Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.,* and F. L. MORRITZ, *Sinclair Research Laboratories, Inc.*

PHOTOCHEMICAL REACTIONS by C. R. MASSON, *Atlantic Regional Laboratory, National Research Council of Canada, Halifax,* and V. BOEKELHEIDE and W. ALBERT NOYES, *University of Rochester, Rochester, N.Y.*

ELECTROLYTIC REACTIONS by SHERLOCK SWANN, JR., *University of Illinois, Urbana, Ill.*

VOLUME III

Second Completely Revised and Augmented Edition. In two parts.

PART I: Separation and Purification

1956. 883 pages, 397 illus., 57 tables. $17.50

PART II: Laboratory Engineering

1956. 400 pages, 143 illus., 38 tables. $8.00

VOLUME X FUNDAMENTALS OF CHROMATOGRAPHY

By H. G. CASSIDY, *Sterling Chemical Laboratory, Yale University, New Haven, Conn.*

1957. 465 pages, 85 illus., 61 tables. $11.00

METHODS OF BIOCHEMICAL ANALYSIS, VOLUME IV

Edited by DAVID GLICK, *Professor of Physiological Chemistry, University of Minnesota, Minneapolis, Minn.*

1957. 372 pages, 46 illus., 29 tables. $8.50

THE LIPIDS

Their Chemistry and Biochemistry.

In three volumes.

By HARRY J. DEUEL, JR., *Dean, Graduate School, and Professor of Biochemistry, University of Southern California, Los Angeles, Calif.*

Volume I: THE CHEMISTRY OF LIPIDS

1951. 1008 pages, 102 illus., 341 formulas, 183 tables. Extensive references. $21.00

Volume II: BIOCHEMISTRY: Digestion, Absorption, Transport and Storage

1955. 948 pages, 31 illus., 139 tables. Extensive references. $25.00

Volume III: BIOCHEMISTRY: Synthesis, Oxidation, Metabolism, and Nutritional Importance

1957. Approx. 1000 pages.

FUNDAMENTALS OF IMMUNOLOGY

Third edition, completely revised and rewritten.

By WILLIAM C. BOYD, *Professor of Immunochemistry, Boston University, School of Medicine, Boston, Mass.*

1956. 790 pages, 74 illus., 95 tables. $10.00

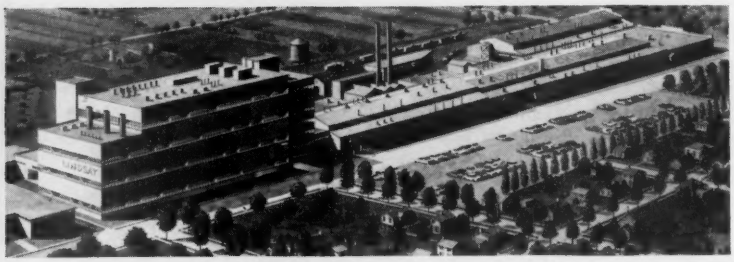
INTERSCIENCE PUBLISHERS, INC.

250 Fifth Avenue, New York 1, N.Y.

Want a Carload of Rare Earths?

They're available for prompt shipment in a gram to a carload

a report by LINDSAY



Back in the early 20's, it would never have occurred to us that in a few years we would be shipping rare earth salts in carload quantities for a surprising variety of chemical and industrial applications.

For a long time, as you may know, the rare earths were simply a by-product of our regular business of producing thorium nitrate for gas mantles. Up to 35 years ago, rare earths were little more than scientific curiosities. Industry had not yet discovered them as a practical scientific tool.

But, as time sped by, we learned more about these unusual elements and how to produce them in larger quantities, in higher purities and at lower cost. And with their increasing availability, industry began to find ways to use them profitably in their operations. In the last ten years, we've seen a sharply increasing rise in the demand for rare earths from a rather amazing variety of industries.

WHY THIS DEMAND? Well, as we see it, it's due largely to the enormous technological strides made since World War II. Industry itself sparked much of this interest by its own explorations of the rare earth group in a search for materials to improve products and processes. Their studies in relation to specific problems often uncovered totally unsuspected applications. It was a sort of chain reaction that is still increasing in velocity.

LINDSAY BUILT NEW PLANT. We saw what an industrial revolution the rare earths were creating. And anticipating heavy demands, we constructed our modern plant in 1953. The Lindsay plant facilities, including more recently developed and improved separation processes (such as our ion exchange systems), increased our production capacity manyfold.

WHAT ARE THE RARE EARTHS? Rare earths are *not* rare—nor are they earths. This group of 15 elements (atomic numbers 57 through 71) are trivalent metals found together with thorium and yttrium primarily in monazite ore. In chemical properties they are almost identical, a fact which makes them difficult to separate and at the same time makes them valuable tools for research and industry.

HOW THEY ARE USED. The fascinating description of industrial applications of the rare earths would fill many books. We work with these materials every day and we're constantly amazed at the variety of ways in which they're used. Here are only a few. Glass polishing. Steel additives. Catalysts. Colorizer and decolorizer for glass. Medications. Ultra-violet light absorber. Arc carbon electrode cores. Aluminum and magnesium alloys. Lighter flints. Radiation-proof glass. Waterproofing. Textile production. Color TV tubes . . . and the list goes on and on.

RARE EARTH SALTS. Lindsay produces rare earth salts in large tonnages and in varying purities. Most of them are surprisingly low in cost. Rare earth chloride—for example—a mixture of several of these elements—is only about 25¢ a pound and available in virtually unlimited quantities. High purity separated rare earths are, of course, more expensive, but economical in relation to the wonders they perform.

HUGE SOURCE OF SUPPLY. To keep up with the demand and assure industries of a steady supply, we maintain in our plant a stockpile of monazite that is now 24,000,000 pounds. And we're constantly prospecting in various parts of the world for this miracle ore —source of the versatile rare earths.

WORTH INVESTIGATING. Your research people may find it rewarding and profitable to study the possibilities of the application of rare earths to your own products and processes. We will be happy to supply pertinent data and to make available to you the help of Lindsay's technical staff.

PLEASE ADDRESS INQUIRIES TO:

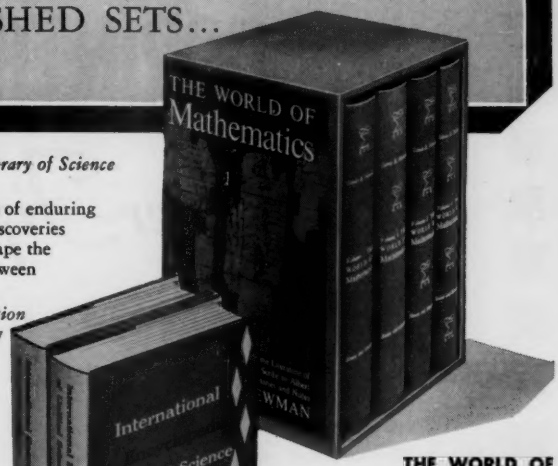
LINDSAY CHEMICAL COMPANY

280 ANN STREET • WEST CHICAGO, ILLINOIS

The Library of Science

INVITES YOU TO ACCEPT AS A MEMBERSHIP GIFT

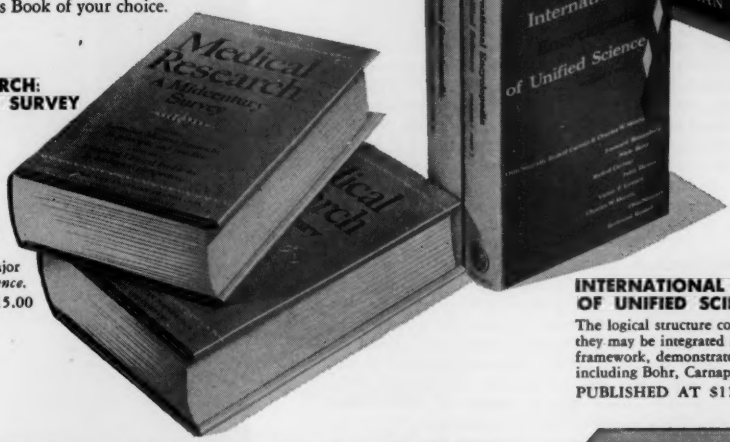
ONE OF THESE DISTINGUISHED SETS...



This invitation is extended to bring to your attention the role of *The Library of Science* in the work and thinking of 29,500 of your scientific colleagues.

As a member, you will join in receiving, at substantial savings, the books of enduring value in scientific thought and research: volumes presenting the new discoveries of the individual disciplines; books illuminating the personalities who shape the world of science; works that broaden the paths of communication between all fields of inquiry.

To start your membership, choose—*entirely as a gift with your first Selection*—one of the three sets shown alongside. Thereafter, you need take as few as 5 more Selections out of a total of at least 40 that will be offered at reduced Member's Prices during the next 24 months. After every fourth Selection taken, you *also* receive a free Bonus Book of your choice.



MEDICAL RESEARCH: A MIDCENTURY SURVEY
Edited by E. E. Lape. The perspectives of medico-biological research today—progress, methods, problems—analyzed in the light of physical, chemical and mathematical science. 1505 pp. "Truly a major accomplishment." *Science.*
PUBLISHED AT $15.00

THE WORLD OF MATHEMATICS
Edited by James R. Newman. The vast 2500-year panorama of the development of mathematical thought—2535 pages, 500 illustrations—presenting 133 complete books, articles and demonstrations, with 89 interpretative essays by the Editor.
PUBLISHED AT $20.00

INTERNATIONAL ENCYCLOPEDIA OF UNIFIED SCIENCE
The logical structure common to all the sciences, and how they may be integrated into a single methodological framework, demonstrated by 13 leading thinkers, including Bohr, Carnap, Nagel, Russell, and others.
PUBLISHED AT $11.00

Choose any one of these 8 important works as your first Selection

THE DARWIN READER
Edited by Marston Bates & P. S. Humphrey. "All the most important and interesting portions of Darwin's enormous output . . . the essence of his work and thought." *Julian Huxley.*
List price $6.75 Member's price $4.95

THE LAWS OF NATURE
By R. E. Peierls. "A remarkable insight into the logic and unity of physics [and] how the separate ideas fit together to make a wonderfully coherent structure." *Scientific American.*
List price $4.50 Member's price $3.95

THEORIES OF THE UNIVERSE
Edited by Milton K. Munitz. Space, Time and the Creation of the Universe—the first one-volume presentation of the development of cosmology from Plato until the present day.
List price $6.50 Member's price $4.95

MATHEMATICS AND PLAUSIBLE REASONING
TWO VOLUMES. *By George Polya.* Analyzes the methods of scientific problem solving, showing their origins in mathematical reasoning and their applications in other fields of inquiry.
List price $9.00 Member's price $6.50

SCIENTIFIC AMERICAN BOOKS
FIVE VOLUMES. 1082 pages, paperbound, on: The New Astronomy; Atomic Power; Automatic Control; Physics and Chemistry of Life; Animal Biology.
List price $5.00 Member's price $4.50

A HISTORY OF SCIENCE
By George Sarton. The leading scientific historian of our time recreates the science of antiquity, from the beginnings of writing to the flowering of Greece.
List price $10.00 Member's price $6.95

READINGS IN THE PHILOSOPHY OF SCIENCE
Edited by Herbert Feigl & May Brodbeck. Partial contents include: Nature of Scientific Method; Theory Construction; Logic of Scientific Explanation; Testability and Meaning.
List price $6.00 Member's price $4.95

FRONTIERS OF ASTRONOMY
By Fred Hoyle. "The directions in which astronomical thought is tending on the frontiers of astronomy . . . discussed in a fascinating manner." *The (London) Times.*
List price $5.00 Member's price $3.95

The Library of Science
59 Fourth Avenue, New York 3, N. Y.

Please enroll me as a member and send the works indicated below, one as my Membership Gift on joining, and the other as my first Selection (to be billed at the reduced Member's Price plus a small shipping charge). I need take as few as 5 more Selections in the next 24 months, and after every fourth Selection, I will receive a free Bonus Book of my choice.

Membership Gift

First Selection

Additional Selection desired

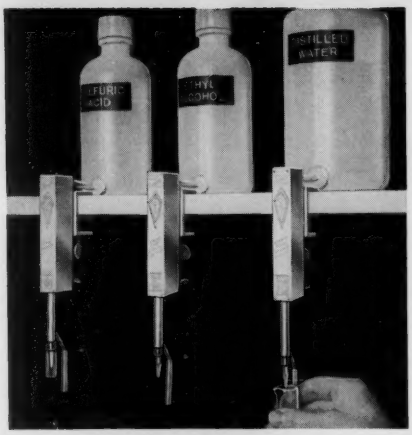
NAME

ADDRESS

CITY ZONE STATE

421

Palo INTRODUCES A NEW LABORATORY CONVENIENCE

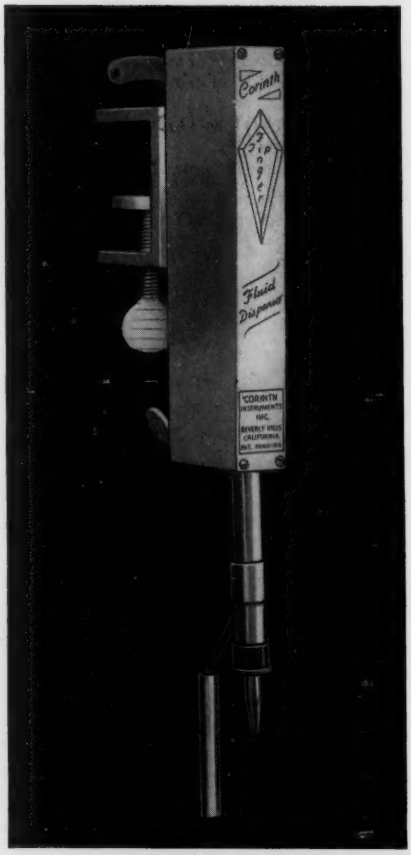


the CORINTH *Finger-Tip* FLUID DISPENSER*

★ Quick, easy to use . . . operates at touch of hand or container!

★ Accurate . . . positive delivery control to the drop!

★ Sterile . . . safe . . . even for dangerous chemicals!



This universal semi-automatic fluid dispenser eliminates losses, contamination, unwieldiness and guesswork of old-fashioned bottle-pouring. Ideal for frequent dispensing of small amounts of fluids for routine laboratory, pharmaceutical and hospital needs . . . reagents, medicinals, pharmaceutical syrups, elixirs and liquors, sterile solutions, corrosives, volatile solvents, liquids of all types. Can be drop calibrated for quantitative delivery of milliliter amounts, or will deliver one pint or more per minute in the fully opened position.

Liquids pass through glass and taste-free chemically resistant polyvinyl or polyethylene plastics. Outer construction is of stainless steel and anodized dichromate-sealed aluminum, for maximum resistance to corrosion and lifelong trouble-free operation, attractively finished by the alumilite process. Safety lock-knob prevents accidental opening when not in routine use . . . nozzle vial shield prevents vapor loss or microbial contamination . . . adjustable platform screw clamps it firmly to shelf or any flat surface. Recommended for use with bottom-tubulated aspirator bottles utilizing gravity feed, or with siphon feed from standard containers and storage carboys.

L-9500-S CORINTH *Finger-Tip* FLUID DISPENSER complete with Pyrex Brand nozzle, shield and Nalgon delivery tubing **$17.50**

ASPIRATOR BOTTLES in Pyrex Brand or Polyethylene available—sizes and prices on request.

*Patent pending

PALO LABORATORY SUPPLIES, Inc.
81 Reade Street • New York 7, N. Y.

MADE BY CARL ZEISS IN WEST GERMANY

LABORATORY AND RESEARCH MICROSCOPE OF HIGHEST PRECISION

MODEL W

Truly the most COMPLETE and VERSATILE microscope of its kind.

In fact, there is so much to say about this magnificent instrument, that only a booklet can begin to list its many features and advantages.

You are invited to write for your free copy immediately . . . and learn why we take justifiable pride in presenting the CARL ZEISS LABORATORY and RESEARCH MICROSCOPE MODEL W.

CARL ZEISS, INC., 485 Fifth Avenue, New York 17, N. Y.

Guaranteed uninterrupted repair service

SARGENT Polarographs*

MODEL III

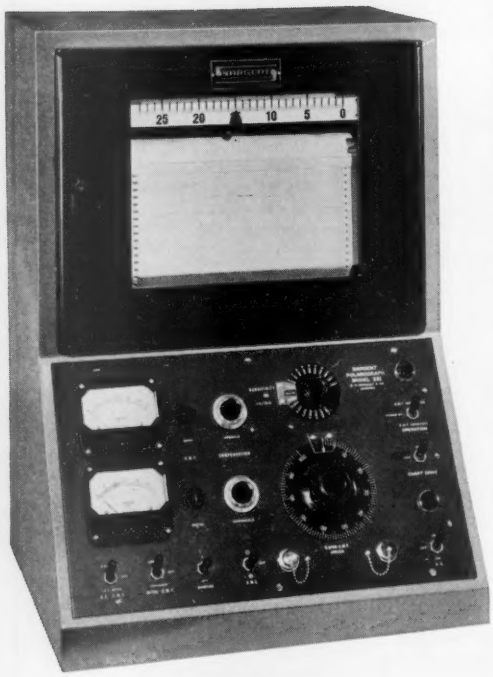
*Trademark Reg. U. S. Pat. Off.

Designed and Manufactured by E. H. Sargent & Co. for all Polarographic Applications in Research and Control Analysis

MODEL XXI POLAROGRAPH—S-29303—Pen Recording, Potentiometric. The complete automatic programming, the combined visual indicator and chart recorder, and the wide flexibility in controls make it most convenient for both research studies and routine analytical applications.

MODEL XII POLAROGRAPH—S-29301—Photographic Recording, Indicating. An adaptation of the original Sargent-Heyrovsky Micro Polarograph, Model X. Recommended for use in routine analyses and research procedures where the step form departs from the theoretical, simple shape and is complicated by maxima, complex formation, presence of several different ions, irreversible reactions, etc. and where it is consequently necessary to have a continuously plotted polarogram.

MODEL III POLAROGRAPH—S-29290—Manual, Indicating. Recommended for use in those routine analyses where only one substance is determined and where the step shape approximates a pure form, characteristic of reversible reactions involving simple ions in fairly substantial concentrations. Also useful in the performance of amperometric titrations and for instructional purposes in educational institutions.



MODEL XXI

Write for our booklet on Polarographs and Accessory Equipment

MODEL XII

SARGENT

SCIENTIFIC LABORATORY INSTRUMENTS • APPARATUS • SUPPLIES • CHEMICALS

Catalog No. 100 Now Available

E. H. SARGENT & COMPANY, 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS
MICHIGAN DIVISION, 8560 WEST CHICAGO AVENUE, DETROIT 4, MICHIGAN
SOUTHWESTERN DIVISION 5915 PEELER STREET, DALLAS 35, TEXAS
SOUTHEASTERN DIVISION, 3125 SEVENTH AVE., N., BIRMINGHAM 4, ALA.

FROM MACMILLAN

BIOLOGY

Hegner & Stiles: COLLEGE ZOOLOGY, 6th Edition 1951 910 pp. $6.75

Stiles: LABORATORY EXPLORATIONS IN GENERAL ZOOLOGY, 3rd Edition 1955 292 pp. $3.75

Mavor: GENERAL BIOLOGY, 4th Edition 1952 875 pp. $6.50

LABORATORY EXERCISES IN GENERAL BIOLOGY 4th Edition 1952 333 pp. $3.75

A BRIEF BIOLOGY 1949 427 pp. $5.50

Huettner: FUNDAMENTALS OF COMPARATIVE EMBRYOLOGY OF THE VERTEBRATES, Revised Edition 1949 309 pp. $6.00

A LABORATORY MANUAL OF COMPARATIVE EMBRYOLOGY 1953 115 pp. $2.20

Lawrence: AN INTRODUCTION TO PLANT TAXONOMY 1955 180 pp. $3.50

TAXONOMY OF VASCULAR PLANTS 1951 823 pp. $9.00

Thimann: THE LIFE OF BACTERIA 1955 776 pp. $13.50

Wedberg: MICROBES AND YOU 1954 439 pp. $4.75

CHEMISTRY

Steiner & Campbell: GENERAL CHEMISTRY 1955 676 pp. $6.50

LABORATORY EXPERIMENTS IN GENERAL CHEMISTRY 1955 216 pp. $3.00

Curtman: INTRODUCTION TO SEMIMICRO QUALITATIVE CHEMICAL ANALYSIS, 2nd Edition 1950 391 pp. $4.50

Kolthoff & Sandell: TEXTBOOK OF QUANTITATIVE INORGANIC ANALYSIS, 3rd Edition 1952 759 pp. $6.50

Conant & Blatt: FUNDAMENTALS OF ORGANIC CHEMISTRY 1950 413 pp. $5.25

Prutton & Maron: FUNDAMENTAL PRINCIPLES OF PHYSICAL CHEMISTRY, Revised Edition 1951 804 pp. $6.50

Delahay: INSTRUMENTAL ANALYSIS March, 1957 384 pp. $7.90

MATHEMATICS

Rider: FIRST-YEAR MATHEMATICS FOR COLLEGES 1949 714 pp. $5.25

Richardson: PLANE AND SPHERICAL TRIGONOMETRY 1950 With tables 481 pp. $4.50; Without tables 343 pp. $3.90

Love & Rainville: ANALYTICAL GEOMETRY 5th Edition 1955 302 pp. $4.00

DIFFERENTIAL AND INTEGRAL CALCULUS 5th Edition 1954 526 pp. $5.75

Rainville: ELEMENTARY DIFFERENTIAL EQUATIONS 1952 392 pp. $5.25

Stewart: THEORY OF NUMBERS 1952 261 pp. $5.75

Nielsen: METHODS IN NUMERICAL ANALYSIS 1956 382 pp. $6.90

PHYSICS

Marshall & Pounder: PHYSICS January 1957 906 pp. $8.50

Black & Little: AN INTRODUCTORY COURSE IN COLLEGE PHYSICS, 4th Edition 1956 786 pp. $6.75

Shankland: ATOMIC AND NUCLEAR PHYSICS 1955 510 pp. $7.50

RECENT IMPORTATIONS FOR YOUR REFERENCE SHELF

Waddington: PRINCIPLES OF EMBRYOLOGY 1956 510 pp. $7.50

AN INTRODUCTION TO MODERN GENETICS 1950 441 pp. $5.25

Darlington: CHROMOSOME BOTANY 1956 186 pp. $2.75

Darlington & Wylie: CHROMOSOME ATLAS OF FLOWERING PLANTS 1956 519 pp. $10.50

Sambursky: THE PHYSICAL WORLD OF THE GREEKS 1956 255 pp. $4.00

Hutten: THE LANGUAGE OF MODERN PHYSICS: AN INTRODUCTION TO THE PHILOSOPHY OF SCIENCE 1956 278 pp. $3.75

Savory: THE BIOLOGY OF SPIDERS 1956 369 pp. $4.00

The Macmillan Company

60 FIFTH AVENUE, NEW YORK 11, N. Y.

The Microbial World

by R. Y. STANIER, MICHAEL DOUDOROFF and EDWARD A. ADELBERG all of the University of California.

Aware of the need for a general Microbiology text that would be understandable to the beginner without sacrificing accuracy of information, the authors have pooled their knowledge and teaching experience to provide a unique account of the microbial world based on general biological principles. It includes a highly original appendix designed to serve as an introduction or as a review of the principles of cellular biology needed for understanding the material in the text. Wealth of line drawings, original illustrations, charts, tables, footnotes, and extensive bibliographies.

Approx. 672 pages • 6" x 9"
Published April 1957 • Text price $8.00

Cytology and Cytogenetics

by C. P. SWANSON, John Hopkins University

Here at last is a unified account of the advances made in cytology and cytogenetics. Information derived from recent studies vastly contributes to a clear understanding of the structure and behavior of cells—both as units of organic heredity and as evolutionary potential. This work emphasizes modern experimental approaches that deal with the mechanisms and the interrelations of form and function. Unusually comprehensive, the text thoroughly covers—viruses, bacteria, and fungi in addition to the higher life forms.

Approx. 608 pages • 6" x 9"
Published April 1957 • Text price $10.00

NEW BOOKS

Solid State Physics

by A. J. DEKKER, University of Minnesota

The emphasis in this new text has been placed on a clear exposition of the physical reasoning and of the physical models on which the interpretation of the observed properties of solids is based. The book is divided into two parts. Part I deals with topics which may be discussed in terms of atoms, with little or no explicit reference to the electron theory of solids. Part II deals with the electronic properties of solids.

Approx. 544 pages • 6" x 9"
Published April 1957 • Text price $9.00

Nuclear Reactor Physics

by RAYMOND L. MURRAY, North Carolina State College

Features: based on lectures to undergraduates and graduate students in Nuclear Engineering over a 6-year period . . . many numerical examples illustrate theory, drawn from practical situations in reactor design field . . . approximately 100 problems, with answers . . . clear, simple explanations of heterogenous reactor flux solutions, two-group matrix method, spherical harmonics approach, control rod theory, slowing in hydrogenous mixtures, and others.

317 pages • 6" x 9"
Published April 1957 • Text price $7.50

Approval copies available from:

PRENTICE-HALL, INC. Englewood Cliffs, New Jersey

26 April 1957, Volume 125, Number 3252

SCIENCE

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

LAURENCE H. SNYDER, *President*
WALLACE R. BRODE, *President Elect*
PAUL B. SEARS, *Retiring President*
PAUL M. GROSS
GEORGE R. HARRISON
PAUL E. KLOPSTEG
CHAUNCEY D. LEAKE
MARGARET MEAD
THOMAS PARK
WILLIAM W. RUBEY
ALAN T. WATERMAN
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

DAEL WOLFLE, *Executive Officer*
GRAHAM DUSHANE, *Editor*
CHARLOTTE V. MEETING, *Associate Editor*
JOSEPH TURNER, *Assistant Editor*

Editorial Board

WALLACE R. BRODE — EDWIN M. LERNER
BENTLEY GLASS — WILLIAM L. STRAUS, JR.
KARL LARK-HOROVITZ — EDWARD L. TATUM

Editorial Staff

PATRICIA L. CARSON, MARY L. CRABILL, SARAH S. DEES, NANCY S. HAMILTON, OLIVER W. HEATWOLE, YUKIE KOZAI, ELIZABETH MCGOVERN, ELLEN E. MURPHY, ROBERT V. ORMES, BETHSABE PEDERSEN, MADELINE SCHNEIDER, JACQUELYN VOLLMER

EARL J. SCHERAGO, *Advertising Representative*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature* and in the *Industrial Arts Index*.

Editorial and personnel-placement correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, book reviews, and illustrations, see *Science* **125**, 16 (4 Jan. 1957).

Display-advertising correspondence should be addressed to SCIENCE, Room 740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. If possible, furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

About Books

What is a book? A silly question? Not at all, for the problem of definition is, as is usual in any discussion, a thorny one. One could render any kind of statistical discussion of books almost impossible by accepting the functional definition given by Franklin Spier, an American publisher: "A book is a book only when it is read; without a reader it is just so much paper, glue, and cloth." Such a definition suggests the special attitude with which some people approach books. It is a defensible attitude, but would anyone other than a bookman consider an analogous definition for his product? Imagine a butcher saying, "A steak is a steak only when it is eaten; without an eater it is just so much protein, fat, and carbohydrate." And imagination boggles at the task that would be faced by an anatomist, or especially an embryologist, if he attempted to apply similar definitions in naming parts of the body.

But, no matter how we define books, we can agree with the statement of the writer of Ecclesiastes: "Of making many books there is no end." He may have been lamenting the laborious production of books by hand, as is suggested—at least to a novice in exegesis—by the completion of the sentence with "and much study is a weariness of the flesh." But to take the text literally as a blunt statement of fact is also possible and more relevant to our times, when books flood from the presses in an ever-widening and endless stream.

How big a stream? How many books? Even if books are defined as physical units, the best answer is still an approximate one, for definitions differ from country to country. According to the UNESCO *Courier* for February 1957, definitions of books differ in some of the following ways. In the United Kingdom, any publication priced at sixpence or more is a book. In other countries, a minimum number of pages defines a book: 17 in Iceland, 64 in Hungary, 100 in Italy and Ireland. In still others, there is no fixed definition: India, Indonesia, and the U.S.S.R. make no distinction between books and pamphlets but classify them all as books. The U.S. makes a commercial distinction: pamphlets and governmental publications are excluded unless they are sold commercially.

UNESCO proposes that a book be defined as a "nonperiodical publication containing 49 or more pages"; that both books and pamphlets should be included in national tabulations but recorded separately; and that government books, atlases, reference books, and academic papers be included if they are sold commercially.

Until such agreement is reached, we can do no more than give estimates based on differing standards and varying statistics. UNESCO estimates that some 60 countries publish books at the rate of more than 5000 million annually. A startling figure and one that would doubtless have made the author of Ecclesiastes "stare and gasp." It is not so startling when it is compared with the world population. In these terms the annual production of books is only about two per person or about four per person capable of reading.

So much for quantity. Quality is a different matter, as we can see when we look at a list of the ten best sellers in the U.S. during the last 60 years. The list is topped by Charles Monroe Sheldon's *In His Steps* (8 million copies), and Micky Spillane occupies three of the ten places with *I, the Jury, The Big Kill,* and *My Gun Is Quick.* The inadequacy of a quantitative criterion for judging books is apparent; the list illustrates the aptness of Logan Pearsall Smith's remark: "A best seller is the gilded tomb of a mediocre talent."—G. DuS.

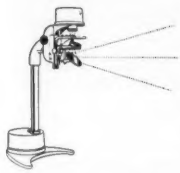
HOW BAUSCH & LOMB EDUCATIONAL INSTRUMENTS

MAKE SCIENCE EASIER TO TEACH, EASIER TO UNDERSTAND...

• B&L TRI-SIMPLEX MICRO-PROJECTOR

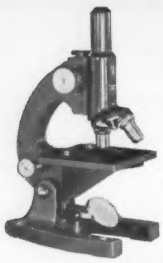
Projects more vivid views of microscopic specimens—easier to see and understand—than any other micro-projector anywhere near its low budget price. Easy projection of:

1. Screen images of prepared microscope slides



2. Screen images of living micro-organisms in liquid

3. Table-top images for tracing



• B&L "FL" MICROSCOPE

Standard size and operation; students learn better—the *right* way. Pre-focusing gage saves valuable class time. 100× and 430×.

• B&L MACROSCOPES

Versatile general science teaching tool. Ideal for gross specimen studies, dissection; handy for field trips. 10×, 20× or 40×. With stand (as shown) or folding tripod.

• B&L BALOPTICON® PROJECTORS

Brilliant full-screen images of slides, opaque objects, even chemical reactions!

• B&L STEREOMICROSCOPES

Natural 3-D detail, widest field of view, simple to use. 6.6× to 150×.

• B&L SPECTROSCOPES

Easy-to-see spectra of elements make chemical analysis easy to understand.

TRY THEM! USE THEM!
SEE FOR YOURSELF IN
FREE CLASSROOM DEMONSTRATION!

(Just Mail Coupon)

BAUSCH & LOMB
SINCE B&L 1853

BAUSCH & LOMB OPTICAL CO.
75916 St. Paul St., Rochester 2, N. Y.

I'd like ☐ a demonstration, ☐ catalogs, on:

☐ Tri-Simplex Micro-Projector ☐ "FL" Microscope
☐ Macroscopes ☐ Stereomicroscopes
☐ Balopticon Projectors ☐ Spectroscopes

NAME .....
TITLE .....
SCHOOL .....
ADDRESS .....
CITY ..... ZONE ..... STATE .....

26 April 1957, Volume 125, Number 3252 SCIENCE

Literature, Science, and the Manpower Crisis

Joseph Gallant

Before me is the revised edition of the *Cyclopedia of English Literature,* edited by Robert Chambers in 1843 and republished in 1858, which claims "to provide a systematized series of extracts from the best productions of English intellect from Anglo-Saxon to the present times in the various departments headed by Chaucer, Shakespeare, Milton—by More, Bacon, Locke—by Hooker, Taylor, Barrow—by Addison, Johnson, Goldsmith—by Hume, Robertson, Gibbon—set in a biographical and critical history of the literature itself."

Observe the comprehensiveness of the implied definition of literature. Included are theologians, historians, and philosophers. The actual contents confirm this universality. In the section on prose of the "Third period—reigns of Elizabeth, James I and Charles I" we find, among many other similar items, a discussion of "The languages of ancient Britain" taken from Holinshed's *Chronicles;* a eulogy of "The sea" by Samuel Purchase, which has a Rachel Carson flavor; a bit of natural history on "The chameleon," in Scottish, by George Buchanan; and a bit of unnatural history on "How witches travel," by King James I.

In "The fourth period—the Commonwealth," the *Cyclopedia* uses systematic subdivisions (which set the pattern for later historic periods) for "theologians," "historians," "essayists," and "metaphysical and scientific writers." In the last category are included Sir Isaac Newton, Robert Boyle, and even such a technical discussion as "Proportionate lengths of necks and legs of animals," by John Ray, which ends with this aphorism: ". . . for nature makes not a long neck to no purpose."

The *Cyclopedia* was not an aberrant critical or anthological work. It was a standard work of reference. It was reprinted in this country by Lippincott in 1869, in a handsome leather binding, and apparently had a wide circulation.

What I am concerned with here is the presupposition, which this work demonstrates, that literature, in the early 19th-century view, comprehended writings other than belles-lettres. This was traditional. Samuel Johnson, in the 18th century, included theologians and philosophers among the poets. All insights into the nature of the universe, of man, of society, were the proper province of literature. Similarly, in ancient times, sacred literature included allegory, apocalyptic vision, moral disquisition, but also history and legal compilations. Latin literature included a tract on farm management by Cato the Censor, works on architecture by Vitruvius, Pliny's *Natural History,* and Lucretius' poem *De Rerum Natura,* dealing with physics, cosmology, and ethics.

Literature Grows Narrower

It was only in the course of the 19th century, and particularly toward the end of Victorian times, that the domain of literature was truncated. This occurred for two reasons.

As various sciences and disciplines matured, their subject matter became ever less speculative and philosophic, ever less the projection of personal sensitivity and insight. Rather, this subject matter became ever more technical, rigidly systematic, mathematical, and either experimental or clinical. The earlier analyses and reflections were, therefore, personal and imaginative. The later developments became more impersonal and generalized. Adam Smith, John Stuart Mill, or even William Graham Sumner may be said to have written literature. The works of later social scientists, in parallel fields, are technical science. William James wrote what might still be called literature; contemporaries write psychology. Boyle's or Newton's revelations might have been literary. A contemporary report in nuclear physics, or a doctoral paper on semiconductors, is not; it is a specialized technical report. It is incomprehensibe to the literate and educated layman, not trained in the symbols, language, methods, and customary thought processes of the specialists in the field.

This is our cue to differentia. Literature may be said to include the pristine evaluations of experience in some new areas, the intuitions which are personal and fresh and usually weighted with emotion and lyric delight of discovery which can be transmitted to the reader. It can be apprehended by the intelligent nonspecialist. As the body of knowledge in the area grows, as its special terms of reference evolve and crystallize, as it makes more and harsher demands upon the reader in the way of manipulative intellectual techniques, an area secedes from the field of literature and becomes a separate discipline. This evolution occurred early in medicine, in metaphysics, in theology, and in ethics; then in the natural sciences, throughout the 19th century; then in linguistics, sociology, economics, archeology, and history; and finally, within the memory of living man, in anthropology, psychology, and esthetics.

The second factor in narrowing the province of literature was the emergence, at the close of the 19th century, of the doctrine of the autonomy of the arts. The heightened self-consciousness of artists in the use of their tools (for whatever historic and social reasons) gave rise to "art for art's sake." This tended to alienate the artist from subject matter and content and made him concentrate on the technique of his craft, in various modes and degrees—from Edgar Allan Poe and Flaubert through the symbolists, the "mauve

The author is chairman of the English department at the Theodore Roosevelt High School, New York, N.Y.

decade," the impressionists, the post-impressionists, the imagists, the cubists, and even the dadaists. Art became "pure," content became inconsequential, pretendedly. One no longer dared ask what a poem had to say; one could only speculate on how poorly or how well it expressed the ineffable. "A poem should not mean, but be," said Archibald MacLeish, about 30 years ago.

Reading Syllabus Impoverished

This would appear to apply only to the *avant-garde,* to the cliques and schools of the arts. Mass art may be said to have continued to be sententious and sentimental. However, the impact of the esthetic schools ultimately was felt in the academic world in the first quarter of our century. University English departments ultimately conditioned the literary values in teacher-training institutions and among teachers, textbook writers, and school administrators. The result was an ironic cultural lag.

"Art for art's sake" was manifest in what the schools taught as literature a quarter of a century after it had ceased to be a battle call among writers, while, in today's adult population, the cultural lag is perhaps as much as a half-century, and, to the popular mind, an expository work in history, science, or philosophy no longer carries the cachet of literature.

Now this is not a question of lexicography, nor one of purely academic definition. The consequences are felt in our cultural life. They are shown in the curriculums of our schools. Thus, in the 19th century, certain political orations became commonplace works, studied as literature—for example, Burke's speech on conciliation with the Colonies, Washington's farewell address, and Daniel Webster's orations. These survived in the syllabus of the high-school English class as established classics well into our own time and are still taught, if rather apologetically, where modernization has not been seriously stressed. However, equivalent forensic works of our own or of recent times would receive scant consideration by present-day curriculum planners in the field of English and literature. The works cited are on political themes, but writings and speeches in the fields of history and science are equally neglected.

Cultural Lag in the Humanities

The most conspicuous aspect of our civilization, today, is the pervasive and ramifying impact of science in every department of life, from household management to warfare. Yet it is curious to observe how little, relatively, the scientific outlook has permeated our cultural life. I use the term *culture* not in the anthropologist's sense but in the more familiar way, to cover the arts, the humanities, entertainment, and the communication media. The case is most conspicuous in literature. Again, comparisons with other ages are revealing.

Slight, comparatively, as were the general or practical consequences of physics or astronomy in the early 18th century, Alexander Pope's great didactic poems reflected the teachings of Newton, to mention only the outstanding instance. In the 19th century, the work of so dreamy a romantic as Shelley is interlaced with the new scientific perspectives of his age. Tennyson and Arnold showed the surge of new scientific concepts. So did Whitman in America. Emerson made abundant use of the new ideas in geology and biology, which stirred the imagination. In the narrower field of poetry of the machine, Carl Sandburg and Hart Crane exploited new possibilities almost 50 years ago.

Now consider the overwhelming new concepts and insights provided by science in the last 30 years: galaxies beyond, the expanding universe, subatomic particles, entropy, genes, the immortality of chromosomes, atomic energy, Hoyle's continuous creation, matter as wave motion, the various implications of relativity, the original ylem of creation, the succession of species, the life and death of stars. All these challenge the imagination. How little they have been exploited by poets! Robinson Jeffers has employed one phase of biological perspective to extend into our time some of the stunned and perhaps naive disillusionment of the Victorian reaction to Darwin. Archibald MacLeish wrote a moving poem, "An epistle to be left in the earth," and Mark Van Doren wrote an exalted "God of the galaxies." Beyond these—nothing. Not quite; several dozen glib satirical pieces have appeared in magazines, chiding science for man's interference with God's ways. These do not absorb and poetically reintegrate the new outlook, the new constellations of ideas forged by the science of our time. The revelations and the moods presented are trivial variations on themes already centuries old.

Recently, Helen Plotz edited *Imagination's Other Place,* a thin compilation of poems of science and mathematics. The anthology shows exhaustive and painstaking research. The editor has to lean heavily on Emerson, Masefield, Hardy, and Shelley. She culled her most deeply felt lyric passages from Lucretius and the Book of Job. Where are the contemporaries? John Ciardi is represented by a warning against scientific disaster, reminiscent of the sermons against the "iron horse." The other living poets are flippant about flying saucers and the like.

It is instructive to examine such a lexicon as the *Reader's Encyclopedia,* compiled by William Rose Benét, a literary scholar of scope and judgment. In it may be found listed the unicorn and the music of the spheres, but not the awe-inspiring new elements in today's cosmology, or the hair-raising imaginative ideas of the other sciences of our time.

What is true of poetry and of literary reference is equally true of the drama, the novel, and the humanities in our schools. College presidents and professional societies issue dicta about the urgency of spicing technical training with "the rich leaven of the arts." Professors of science apologetically admit the straitened confines of technologic studies and defer to the deeper wisdom of the humanities. But the humanities sweepingly ignore the role played by scientific insight and thinking in the ideology of our times and disdainfully march on their archaic way as though the atomic and electronic age had not yet arrived.

Scientific Manpower Shortage

At the same time the *New York Times* reported, in a review of the year in education, on 1 Jan. 1956: "The National Manpower Council has drawn attention to the great shortage of teachers, scientists, engineers, and technicians of various kinds." Lewis L. Strauss, chairman of the Atomic Energy Commission, pointed out at the Thomas Alva Edison Institute, in 1955, that in 1956 the United States was graduating about half as many engineers and scientists as the nation's industry and research programs needed, and that in the decade 1950–60, the Soviet Union is expected to produce 1.2 million trained engineers and scientists to our 900,000.

"The new thing," said James Reston in the *New York Times* on 5 Dec. 1955, "is that education is now being argued out in the National Security Council where the views of men like Mr. Dulles and Mr. Strauss can have some effect."

Public and private agencies concerned with scientific manpower have focused their attention on recruiting students for science and engineering courses in the colleges and on improving the quality of science teaching in the high schools. Strauss has even proposed that the study of physics and chemistry be made obligatory, in high schools, for college candidates.

But to solve our scientific manpower shortage, we cannot, in the long run, depend on coercive syllabi. The Soviet Union is said to enforce fixed curriculums heavily weighted with technical studies. But the Soviets are also reported to pay the highest emoluments to engi-

neers and technicians and to make a veritable cult of science, so that scientists constitute a venerated elite. It is doubtful whether, in this country, the lure of higher pay for scientists will succeed, in the absence of other influences, in attracting a sufficient number of recruits into scientific professions, for, in our society, there will remain the countervailing attraction of rival fields of enterprise. The scientist is generally a salaried employee, while the free entrepreneur, if he has initiative, and the executive, if he has ability, will command greater authority, greater economic opportunity, and greater social prestige. It is reasonable to believe that increased remuneration will draw more qualified young men and women into scientific fields, but it is equally reasonable to seek to create additional and perhaps deeper and more sustained incentives.

The many organizations concerned with our present and prospective shortage of scientists, engineers, and technicians are now engaged in campaigns to improve teaching methods in the sciences on various educational levels, in the colleges and in the secondary schools. Similarly, they seek to improve the facilities and equipment in the schools. They have mobilized a massive program of public education to secure financial support from both governmental and private sources for scholarships, endowments, and appropriations, to expand and strengthen science teaching. They have succeeded in arousing our citizenry to an awareness of the urgency of the problem.

Arousing Youth's Imagination

However, a serious shortcoming of this campaign lies in this fact: students must be attracted to the study of sciences, not *after* they are enrolled in science courses in the colleges, but *before*; not after they have elected physics and chemistry in the secondary schools, but before they do so. Moreover, while they are engaged in what, to them, is the exacting and arduous work of science and mathematics classes on the high-school level, they must be endowed with a perspective that will provide them with a profound and continuing motivation to apply themselves.

It is a commonplace that European students are subjected to a rigorous course of study in *lycée* and *gymnasium,* and that they study with single-minded assiduity. Their *continuing* motivation is to be found in the traditional prestige attached, in their cultures, to the baccalaureate and doctoral degrees and to the code among students which puts a high value on scholastic achievement. Thus, a German or Scandinavian business executive not uncommonly has a doctorate. In France, it is notorious that suicide rates are high among young people who have failed in their baccalaureate examinations.

Our culture, and the codes prevalent among our students, do not prize scholastic achievement so highly. Strong motivation for young people to persist in difficult studies must be found in the intrinsic appeal of the areas of study as well as in the pecuniary rewards offered by the goal—the profession for which their studies prepare them. The intrinsic appeal of the sciences can be found in the emotionally satisfying, dynamic concepts which modern science employs—the very list referred to in a preceding paragraph as stimulating to the imagination. The intrinsic appeal of science can be found in the splendor and the magnitude of the ideas which it handles, in the feeling of awe which its universalized observations provide, and in the sense of workmanship, order, and organization which is satisfied in the pursuit of one of its topics or objects of investigation.

Now it is in the very nature of the process of specialized study in a specific science that some of these appeals should be attenuated. The pursuit of technical details in the laboratory often militates against the sweep and majesty of basic theories and emotion-laden hypotheses.

Where, then, can the emotional and imaginative appeal of modern science be conveyed to the student? Obviously, in the humanities and the arts, generally, and, most specifically, in the study of literature. Literature always pinpoints individual sensibility and the relationship of the individual, the writer, the reader, or the character examined, to the world around him. It is literature which can most appropriately project the emotional impact of the scientific outlook on the individual.

It is in literature, in the arts, and in social studies that students may learn to recognize the scientific outlook and to be aroused to the romance, the wonder, the reverence, the adventure of modern science. They may learn enough about what science is to be able to elect science courses intelligently. The appeal of science to the student has usually been in the nature of a calling, a mission. Teachers have found some students who were enamored of science before they began to study physics or chemistry or biology. The number can be increased by offering young students insight into what science offers to mankind in general, and to the private imagination as well, before they begin their regular scientific and technical study.

Observe the opportunities in high-school English classes. High schools do not offer, and are not geared to offer, such subjects as astronomy, cosmology, oceanography, geology, paleontology, archeology, or anthropology. But consider the vast number of imaginative and well-written books which have been put out since World War II, alone, dealing with these subjects at the level of the intelligent layman. I list only the most conspicuous of the best sellers which, by their sales, reveal that they contain no technical hurdles and that their attractiveness for the literate, adult layman is great: Rachel Carson's *The Sea Around Us,* George Gamow's *Life and Death of the Sun,* Fred Hoyle's *Nature of the Universe,* Patrick Moore's *Guide to the Planets,* Roy Chapman Andrews' *Meet Your Ancestors,* William White Howell's *Back of History,* C. W. Ceram's *Gods, Graves, and Scholars,* Ruth Moore's *Man, Time, and Fossils.* That scientific writing on a nontechnical level holds the interest of the lay public is revealed by the increasing space given to such material in periodicals such as *Harper's* and the *New York Times Magazine. Life* ran a series, in 1952–54, entitled "The world we live in," and is currently publishing a series on anthropology. The man on the street definitely has an appetite for scientific revelation. *The Scientific American,* a monthly magazine, has increased its circulation in the last 8 years to the hundreds of thousands, despite the fact that it is quite technical and makes few concessions to the ignorance of the layman.

English Syllabus Neglects Science

We must now return to our initial discussion. Up until 70 or 80 years ago there would have been little question that such books as those listed in the preceding paragraph belonged properly in the jurisdiction of literature. They are neither textbooks nor technical reports for specialists. They serve the purpose of communication to a general public. It is, perhaps, time that we returned to this pristine notion of what is literary. I am not quarreling with library classification practices, though, in passing, we might note two pertinent anomalies—the result of our present adoration of specialization. *Great American Nature Writing,* assembled and edited by Joseph Wood Krutch, is assigned by our libraries, under the Dewey decimal system, to the area of biology, although Krutch, certainly eminent as a literary critic, essayist, and historian, spends his 80 pages of lucid prologue discussing nature-writing as literature. Similarly, Roy Chapman Andrews' *My Favorite Stories of the Outdoors,* which consists predominantly of fiction—of short stories—is classified under biology. I have no quarrel with librarians; let them have it as they will.

But those responsible for the syllabi in English must learn to look for material on the nonliterary shelves.

The American Association for the Advancement of Science has organized a library of 200 books dealing with general and broad aspects of science, from archeology to engineering. This library is circulated to small high schools to stimulate interest in science among students in out-of-the-way districts. The books listed were recommended by professional scientists and educators and were subjected to scrupulous counterchecking, for readability, by experienced teachers. Of the 200 books, 112 have proved to be of interest to high-school students in 66 program schools, during 1955–56. Observe, in contrast, the treatment of science reading in an official publication of the National Council of Teachers of English, the *Combined Book Exhibit* of recommended, supplementary reading. The exhibit was held by the National Council of Teachers of English at its New York convention in 1955. The books exhibited were listed in a graded, and annotated, printed bibliography, published by the council, which, in practical effect, will become an official guide to teachers on books to recommend. Under the heading "Seeking to understand the universe," this bibliography lists only one book on the high-school level. The annotation for this book is: "A selection of 365 readings from the main stream of devotional writing, one for each day of the year." Science is not regarded as even having any relevancy in "seeking to understand the universe."

Under the general heading "Seeking to understand the world around you," the *Combined Book Exhibit* contains subdivisions on living things, on the physical world, on material things and inventions, and on space and ocean depths. Under the first subdivision there are 72 items of natural history for the elementary-school level, but only seven books are listed as suitable for grade 9, and above. None of these deals with basic biological concepts, and none is on the higher intellectual level suitable for the high school proper, as distinguished from the junior high school, although the traveling library of the American Association for the Advancement of Science lists at least 75 items in the biological sciences, including medicine and paleontology. Under "material things and inventions" there are several elementary-school listings but only two for the "ninth grade and above," one a gazetteer and one the story of gold. Again, nothing is listed on a more challenging level for the upper grades of the high school. Under "the conquest of space and ocean depths," only three books for the tenth grade, and above, are listed, and these, while worthy, do not touch the profound, evocative ideas of modern science. One is an account of wartime torpedoes; one, an account of "man under water"; and one, a discussion of unaccomplished engineering fantasies! Under the more comprehensive heading, "the physical world," there are nine listings for "grade nine and above," none specifically for the higher grades or higher intellectual levels. One, only, of the nine, *Design of the Universe,* by Fritz Kahn, presents a comprehensive overview of the hypotheses and speculations of today's science. Another, an excellent, reputable, and adult book, Waldemar Kaempffert's *Explorations in Science,* is focused chiefly on new processes and inventions—on the laboratory, not on general perspective. *Atoms Today and Tomorrow,* by M. O. Hyde, is concerned with a narrow treatment of atomic energy from a utilitarian standpoint. The others, while worthy, deal with such restricted areas as science in the service of the police, mountaineering, and practical meteorology. Observe that these few recommendations for science reading occur in a total bibliography of more than 900 books.

Contrast the listing with that of the American Association for the Advancement of Science. It is almost as though the English teachers' association had planned to misdirect student attention; to guide it into arid and narrow channels dealing with gadgetry, pet-care, and the trivial curiosities of science; to divert student attention from the breath-taking vistas presented by literally hundreds of contemporary expository works for the layman. A sinister group, determined to inhibit the growth of an interest in science reading among high-school youth and to forestall development of a passion for scientific studies, could hardly have planned better.

No Dichotomy—Science Belongs with the Humanities

Now I am not suggesting that a foreign power has a cell operating in the National Council of Teachers of English. What is apparent is the dichotomy in our culture. On the one hand, science is respected, but, perhaps, among nonscientists (and this includes teachers and writers), with the same mixed fear and regard that are felt for the medicine man among primitive groups. On the other hand, in our everyday attitudes and dealings, science is left out of account. So, also, science is left out of account in our view of our relationships to ourselves, to one another, and to the universe. Consequently, it is left out of our fine arts and our literature—which, to that extent, are still prescientific. And with this goes the prescientific attitude which a legendary Moslem might have had toward a magic jinnee: that it was a handy, servile monster, ready to be ordered to produce conveniences, gadgets, and occasional miracles. It is this dichotomy which opposes science to the arts and the humanities in conferences of university administrators and curriculum builders.

There need be no dichotomy. It was not inconsistent for Einstein to love the violin. The physicist's recognition of the nature of musical pitch, overtones, and timbre need not militate against his having a deep-felt appreciation of melodic line, harmony, and orchestration. Nor does the musician's sensitivity forbid him to contemplate sound as a phenomenon of nature. The emotions of awe, reverence, love, self-identification, or joy-in-life are not muted by an understanding of mathematical relationship, of atomic structure, or of the chemistry of enzymes. These are not opposites. They are complementary aspects of reality.

The aspect of Western society which has differentiated it from the rest of the world in the last few centuries has been its concern with science. Science is the bedrock of the contemporary world. Without the *Weltanschauung* of modern science, no form of thinking, feeling, or reacting has validity today. No man can see the world except through his modern eyes, and these, in a large measure, are conditioned by the scientific outlook, whether or not he is conscious of it. Not to apprehend this world from the standpoint of science is, therefore, to belie the very process of seeing. To speak in any idiom other than that which incorporates the scientific outlook is to speak the language of the dead—a feat which usually falsifies the meanings and the nuances which that language had for those who lived in the past.

The writer has no choice. The cultural gap which leads him to stand with one foot in the present and one in a prescientific past must be closed, if his message is not to consist of arbitrary and falsified symbols. The poetry of nature is not dead. It has been transmuted into the staggering images of science. When the writer discovers the poetry of the scientific outlook, as Whitman, for example, hoped he would, his work will arouse the young to exaltation. It is this exaltation, alone, that can provide the incentive for hundreds of thousands to devote themselves to scientific careers.

Meanwhile, the courses in the humanities, on the secondary-school level, hold the key to the future of our country and of our society. They can do a twofold job. They can predispose many students, who have the right potentialities, to elect scientific studies voluntarily and eagerly, by showing them the wonder, the vision,

and the excitement of science. And these courses can prepare those who will not be scientists—the writers, the artists, the journalists, the lawyers, the historians, the merchants, the ministers of tomorrow—to share in the scientific outlook and, through it, to enrich the arts and the literature of the future.

What Literature Classes Can Do

Where may our schools begin? They may begin, as literary man in general should begin, by revitalizing the definition of literature to make it conform to its age-old traditional meaning and include all that is profoundly revealing in what is written. In our time, this means such books on science as were listed earlier in this article. We might include some titles that the *Combined Book Exhibit* of the English teachers overlooked: *The Scientific American Reader; The Time Book of Science,* by Jonathan Leonard; *Atoms, Rocks, and Galaxies,* by J. S. Allen; *The Common Sense of Science,* by J. Bronowski; *One, Two, Three—Infinity,* by George Gamow; *Modern Man Is Obsolete,* by Norman Cousins; *Mathematics for the Million,* by Lancelot Hogben; *The Story of Man,* by Carleton S. Coon; *Back of History,* by William White Howells; *Water, Miracle of Nature,* by Thompson King; *A Treasury of Science,* by Harlow Shapley; *The Tree of Culture,* by Ralph Linton; *Magic in a Bottle,* by Milton Silverman; *The Creation of the Universe,* by George Gamow; *Life on Other Worlds,* by Spencer H. Jones; *Our Sun,* by D. H. Menzel; *The Story of Man and the Stars,* by Patrick Moore; *The World We Live In,* by Lincoln Barnett; *Man's First Million Years,* by Jeannette M. Lewis; *Flight into Space,* by Jonathan Leonard; *Unresting Cells,* by R. W. Gerard; *Road to Survival,* by William Vogt; *Nature's Ways,* by C. Andrews; *The Living Tide,* by N. J. Berrill; *Science, the Servant of Man,* by J. Bernard Cohen; *Eleven Blue Men,* by Berton Roueche; *Crucibles,* by Bernard Jaffe; *Rats, Lice, and History,* by Hans Zinsser; *The Next Million Years,* by Charles Galton Darwin; *Mr. Tompkins Explores the Atom,* by George Gamow; *Devils, Drugs, and Doctors,* by Howard W. Haggard; *Men, Microscopes, and Living Things,* by K. B. Shippen.

For the younger student, adventure is the *sine qua non* of vicarious experience through reading. Real adventures in science should be offered to him. The available material is abundant: Roy Chapman Andrews in search of dinosaur eggs in the Gobi Desert; William Beebe in his bathysphere, or considering the natural history of New York; Admiral Byrd taking meteorological readings in the Antarctic; Edwin Way Teale on his naturalistic tours of America; Carl Akeley collecting African wild life; Ernest Thompson Seton drawing the animals of the Canadian and the Arctic wilderness; Thor Heyerdahl on his balsa raft in the Pacific; Gilbert Klingel gathering marine specimens under the Caribbean; the Kelley brothers blowing air into steel crucibles; Ross Allen and Raymond Ditmars hunting snakes; Commander Rosen trying out his Viking rockets; Captain Cousteau with his aqualung; Haroun Tazieff treading volcanic craters and sliding through measureless caves; Louis Slotin testing the critical mass of uranium batches until he died of radiation anemia; and the Burdens in search of surviving prehistoric monsters.

Nor should science fiction be overlooked, even though it is generally derided by schoolmasters. Much in this medium is worthless, but the best specimens are catalysts to the imagination, not to crude and easy fantasies, but to disciplined and orderly marshaling, imaginatively, of the *possible* by extension from the known. Note what a committee of secondary-school principals and professors of education reported about science fiction in the December 1955 issue of *The Bulletin of the National Association of Secondary School Principals,* an issue devoted to "Teaching reading for the gifted in secondary schools."

"If we are to gain a wider appreciation for science, then we must take the opportunity to explore the various areas of science from the purely factual to the fanciful. Scarcely a major technological advance exists that was not at one time a projected image in someone's mind. New discoveries and inventions are outgrowths of man's imagination, thinking, and reasoning integrated with his factual knowledge to produce usable ideas and devices. Effective intellectual growth is achieved when individuals can exchange freely their thoughts and ideas, interpreting and modifying the ideas in the process. For this reason, the gifted should be encouraged to read science fiction in its place. It is through the spark of an imaginative idea that man has been able to improve his environment and himself."

Where science fiction and fantasy are concerned, the function of schooling is to train the student to discriminate between what is significant and revealing, on the one hand, and what, on the other hand, is trivial, absurd, hallucinatory, or vulgar. But education should develop just such ability and sensitivity in regard to all other literary genres as well. Romance or biography may, similarly, be either ennobling or degrading. It is not the genre that is worthy or contemptible but the performance, the content, or the theme.

An Intellectual Reorientation

What applies to the study of literature applies, with equal force, to other subjects. There are art forms that are correlated to science in various ways, through the products of modern industry, through the equipment and processes of the modern factory, the laboratory, and the highway network, and through the functional outlook of modern technology and engineering. History can mold and reenforce the scientific outlook of students. It may attract them to science as a way of life or as a prospective career. It can give greater emphasis to the creative and shaping role of science in our civilization. History can pinpoint the influence of specific sciences and particular theories upon both intellectual and material development.

In sum, what is needed is a reorientation in our intellectual outlook and in our literary and artistic output, accompanied by a reorientation in the teaching of the arts and of the humanities, generally, to gear them to a scientific outlook as part of our effort for preparedness in world competition.

Science, Censorship, and the Public Interest

Gerard Piel

It is no secret that scientists today are enlisting the assistance of writers in order to talk to their fellow-men and to one another. There is even a special and different kind of writer for each purpose. The writer who helps to mediate communication to the public-at-large is, of course, a science writer. The writer whose job it is to facilitate internal communication—the writing of formal papers, reports, and manuals, addressed to other scientists, to engineers, and to technicians—is called a technical writer. Science writing and technical writing now have formal status as professions, with the organization of their respective national societies and the promulgation of their codes of ethics and standards.

The difficulties inherent in external communication are familiar to anyone who has ever tried to write about science for the public. One would think, however, that the internal communications of science might present a situation with ideal matching of impedance between transmitter and receiver. The report, the paper, or the manual is addressed to a small audience. The members of this audience may be presumed to be knowledgeable. They have reason to be interested, and they are compelled to understand. Yet, the technical writer is now accepted by the scientist and engineer in industrial, governmental, and university research organizations as a full-fledged partner and collaborator in the preparation of papers and reports.

Such concern with the technique of communication in this ideal situation suggests the frailty of human communication under any circumstances. It gives us also an impressive measure of the importance of communication in the process of research. It is not too much to say, in fact, that without communication there can be no research. Bishop Berkeley's dictum applies in an exact sense. Like "the tree in the quad" that does not exist if no one is there to perceive it, to borrow from Ronald Knox's restatement of the point, new research has no existence until it is communicated from the scientist to his brothers. The fact is there is no "fact" in science that is final or significant in itself. Work has meaning only as it is connected to the general fund of knowledge and thereby established as a base for further increase of knowledge. It gets so connected and established only by communication. No discovery is ever the work of one man or group of men, working in isolation from the concerns of the community of science as a whole. On the contrary, many discoveries are made simultaneously by two or more independent workers or groups of workers.

This consideration of the function of communication in research underlines the highly practical significance of freedom in the communications of science. Freedom is like the air, however, and we do not appreciate its importance until we are deprived of it. Recent developments in the information policies of our Federal Government, therefore, are instructive. The last two decades of war and cold war have seen a widespread expansion of secrecy in the operation of our Government agencies. The censorship, for obvious reasons, has pressed most heavily upon science. Not only does it blanket large areas of applied science. The technologic revolution in warfare is pushing the frontiers of knowledge; as a result, much work in basic science is classified as "top secret," "secret" and "confidential." And because people, as well as documents, are classified, censorship reaches far outside the Government payroll to embroil a frightening percentage of our scientific establishment in the security system.

All of this has been said before, and it has been the subject for more eloquent protest and indignation than will be sounded here. But there had been no systematic inquiry into the spread of censorship until a year ago, when the so-called Moss Committee of the House of Representatives undertook its investigation of Government information policies. This committee (a subcommittee of the House Committee on Government Operations), headed by Representative John E. Moss of California, has given us a model demonstration of the exercise of the Congressional investigative power. Its quiet and thorough work deserves much better coverage by the press, especially by the press of science. Testimony before this committee has developed, for the first time, the magnitude of the problem of censorship.

Witnesses have agreed that censorship since the outbreak of World War II has locked up something like 100,000 file drawers full of classified documents, in the city of Washington and at United States military and governmental installations throughout the world. The Army estimates that it alone has 2 million classified documents in its files. Such an accumulation of secret material must be deeply disturbing to anyone who prizes the institutions of our democratic society. It is a measure of the degree to which we have permitted anxiety about national security to compromise our traditions and our principles of government. As one eloquent scientist, J. Robert Oppenheimer, has said it: "Our own political life is predicated upon openness. We do not believe any group of men adequate enough or wise enough to operate without scrutiny or without criticism. We know that the only way to avoid error is to detect it, that the only way to detect it is to be free to inquire. We know that the wages of secrecy is corruption. We know that in secrecy error undetected will flourish and subvert."

One report of the Moss Committee reminds us that nowhere in our Constitution or in our statutes is the Executive Department authorized to declare things secret. The Government information statute is itself one of the earliest on our books. It set up rules and regulations for the disclosure of information by public officials and makes no provision anywhere in its language for secrecy. Yet it is this very statute which is now invoked in Presidential orders establishing censorship and secrecy. Now, of course, there is need for secrecy in the operation of government. But censorship has flourished in recent years throughout the Executive Department, without supervision or review by the legislature or by the courts. Perhaps this is because the original statute, making no provision for censorship, made no provision for its review. The Moss Committee is the first agency to undertake such an investigation.

The secret documents that cram the files in Washington relate, of course, to all kinds of concerns of government—to intelligence reports and to forgotten purchase orders as well as to current scientific research. Some of these docu-

Mr. Piel is publisher of the *Scientific American*. This article is based on a paper which he presented at the Conference on Scientific Editorial Problems at the New York meetings of the AAAS, December 1956.

ments probably should not be declassified for a generation; it might be wise, for example, to reserve certain intelligence reports for inspection by future historians. Some documents, however, should never have been classified, especially in realms of fundamental science, and ought to be immediately declassified. But it is clear from the testimony before the Moss Committee that most of these documents will never be declassified. The sheer magnitude of the task and the scarcity of qualified personnel, they say, will make it impossible, no matter how well-intentioned we are and how determined we would like to be. The best the Army hopes to do is to declassify about 10 percent of the documents in its custody, a maximum of about a quarter of a million. Declassification at this rate could not even keep up with the current rate of classification. All of the testimony points to the conclusion that we must seek prevention rather than cure. The most that can be hoped is that some brake on the rubber stamp will slow the accumulation of secret papers.

This is especially important for science, because research tends to stay classified, once the rubber stamp has made its mark. Most strictly military censorship has its own built-in, automatic declassification. The order of battle cannot be kept secret for long, because military plans are self-disclosing as they are put in operation against the enemy. Similarly, the data surrounding the development of a new weapon are disclosed to larger and larger numbers of people as the weapon progresses from the laboratory and the factory to the field. But there is no such automatic process for research. Work in science will stay locked up unless sufficient pressure is brought to bear upon the military to declassify it.

Many fields of science, according to testimony before the Moss Committee, are now compromised by the taint of secrecy. Philip M. Morse of the Massachusetts Institute of Technology told a wry story in this connection. He published what he thought was a novel and significant contribution to queueing, or waiting-line, theory. This is a branch of mathematics that has many uses in a world in which increasing numbers of people are standing in line; it can help planners to schedule the landing of airplanes at crowded airports or to decide how many cash registers to install at a supermarket. When his paper was published, Morse found himself subjected to catcalls from certain colleagues who had been associated in a secret, wartime project with Bernard O. Koopman, now at Columbia University. Koopman, they said, had done the work long ago. Morse had never heard about it because he had not been involved in that particular project, and Koopman's work was still classified. When Morse sought to get the work declassified, he was told that, while Koopman's paper was itself concerned with a no-longer-classified project, it incorporated reference to work by a man named Clark that was still classified. The reason Clark's paper must remain classified, the censors explained, is that nobody has been able to identify this man Clark or to find his paper. Under the circumstances, Morse has taken the only sensible action: he has yielded that salient in the territory of queueing theory to the censors.

We have always opposed the tendency in our Executive Department to make government a private affair. We know from experience how secrecy can shelter corruption and incompetence and promote sterility in the making of national policy. Now we have a new reason for opposing secrecy in the operation of government: it obstructs the progress of science.

Secrecy has injured science in another aspect. It has added a smell of the sinister to the climate of sensation which has surrounded the popular discovery of science as the source of new technology for war and peace. Consider, as a recent instance, the statement by a federal judge that "the younger generation of pure scientists" is suspect of treasonable politics. But we cannot blame the censor exclusively for the poisoning of the public relations of science. The sensations have been expanded and inflated by the publicists of science, even by the well-intentioned, to the point where many of our fellow-citizens have science firmly identified in their minds as an accessory activity of the weaponeering, home-appliance, and pharmaceutical industries.

This brings us to our second concern: science writing, addressed to the public outside of science. This function of journalism has assumed an obvious new importance in our life. The theoretically informed citizenry of our democratic society must be especially informed today about the work of science if it is to make wise judgments in public affairs. But sound public information about science is also integral to the life of science itself, for this is an era in which science must turn to the public for its support.

Science writing has shown great improvement in matter and form in this country in recent years. Most scientists will agree that it is distinguished by greater accuracy and by less flagrant affronts to good taste. As a result, they have accepted the notion of collaboration with science writers, just as they have accepted the notion of collaboration with technical writers. But we have far to go. The principal appeal in the popularization of science is still the one-note siren song of utility. Science, in the public mind, is a means to ends—to all kinds of exciting and useful ends, to be sure: to the space ships that are being delivered this year by our automobile factories, to cancer cures, to bigger bombers and faster jets. As such, science is worthy of public support, the citizen says, provided that it comes through with more of the same. There is peril for science, however, in reliance on this distorted view. The same citizen is showing signs of ennui and anxiety at the prospect of further miracles.

There are other deficiencies. The current vintage of science writing shows a tendency to evade the difficulties of exposition; knotty topics are suspended, instead, in a solution of rich and beautiful prose. In the newer media of communication, which have more recently discovered that science is a matter of large public interest, the popularization of science is confounded by rituals of mass entertainment. One standard routine dramatizes science through the biography of a hero scientist: at the denouement, he is discovered in a lonely laboratory, crying "Eureka" at a murky test tube held up to a bare light bulb. Another treatment invites the audience to identify itself with a hopelessly fatuous master of ceremonies who plays straight-man for kindly, condescending Dr. Science.

All of this, we are told, is what the public wants. But even if it could be shown that the public had a taste for such dubious entertainment (the Hooper ratings are against it) it would still be hard to see how it promotes the popularization of science. The suspicion grows that the mass communication image of science reflects not the public taste but merely lack of ardor on the part of these popularizers.

But publishers and producers are learning that the half-life of bunkum in America is growing short. It is increasingly dangerous to underestimate the intelligence of the American public. Recently there have been notable additions to the casualty list of the American press. And stars are burning out faster these days.

Unhappily, it is an equally good rule for the science writer not to underestimate the ignorance of his public. This applies not only to the public-at-large; it holds equally well in addressing the otherwise educated members of our society. The ignorant include most of the spokesmen and articulators of the public consciousness: our scholars, artists, writers, lawyers, and legislators and our administrators and executives in business and government.

It is this ignorance that underlies the divergence, in the academies of America, between the scientific and the humanities faculties. This is an old story, of course,

dating back to the mid-19th century. It arose from the need to specialize, which has sharpened with the increasing complexity of civilization. But the gulf has widened and deepened in recent years. Ignorance of science is advertised today as the warrant of the self-styled humanist. The argument goes this way: "The aim of education is a decent, moral world made up of decent, moral people. Science must therefore be secondary, because science cannot help anyone to be a decent, moral person. Science is vacant where value is concerned. The humanities provide the value."

The humanities, by this line of argument, are staked out as the territory of the antirationalists. "Reason," they say, "must ever be the slave of passion." Science can show us how to achieve our ends. But for motivation and purpose we must seek guidance elsewhere, in tradition or faith, in the sensibilities, emotions, and yearnings that well up in the human spirit, beyond the understanding and control of reason.

To argue thus is to ignore how much of the outlook of all men in our time is conditioned by science. In politics, the choice of the aims of national policy is profoundly conditioned by what we know, from human biology and from cultural and physical anthropology, about mankind, its history, and its place in nature. Never again can a nation assume the mantle of a "master race" or take up a "white man's burden" or proclaim a "manifest destiny." Cultural relativism has even invaded the world behind the Iron Curtain, where the 19th-century naivetes of Marxism are undergoing revision. The politics of the world is modified, equally, by what we can do with what we know. The vision of the United Nations and its technical agencies is that of a world at peace because it has eliminated human destitution, misery, and disease. Contrast this vision with the view of the 17th-century moralist who held that human life is, of necessity and by definition, "nasty, brutish, and short."

In personal morality, the notion of the good life and of what men live for has been deeply modified by scientific understanding of the cosmos, of the origin of life, and of the structure of the human personality. Reason is the instructor of passion in other departments of our culture. Consider, for example, the bearing of science upon esthetics. Recent investigation of the giant molecules has shown us how nature achieves, in extraordinary perfection, the aim of art: in the molecule, function is the expression of structure; it is what it is because of the way it is made.

Such are the concerns that inspirit the scientist in his work. They are not different from those that move the painter or the composer, the historian or the poet. Utility alone could never have sufficed to bring science to its present wealth of understanding. The motivating drive could never have been less than passions which all men share and which inspire the best achievements of men in other fields of intellectual endeavor.

This is the aspect of science most neglected by science writing. It is, I submit, the facet that is most susceptible to popular appreciation and comprehension. The preoccupation with information should give way to popularization of the objectives, the method, and the spirit of science. If the public is to support the advance of science for motives other than utility, then people must be able to share not only the useful but the illuminating and the beautiful that come out of the work of science.

Abbreviations

Uptake of Laboratory Shorthand in *Science* (ULSS; $Q_{abbr.}$)

Robert V. Ormes

In fitting articles and reports to the necessarily stringent space requirements of *Science*, authors frequently find it convenient to substitute capital-letter abbreviations for nouns and adjectives that they must use several times. The abbreviations are usually ready to hand, for they are used every day in the laboratory to save time and notebook space, and every science, and perhaps even every laboratory, has its own shorthand expressions and jargon. A few authors explain all their abbreviations in a footnote, some explain each abbreviation the first time it is used, some explain some of their abbreviations, and some do not explain any.

To what extent is the use of laboratory shorthand from many different sciences justified in a periodical that circulates among scientists of many different fields? Several points bearing on this question were discussed in a short article that was reprinted from *Nature* in last year's Book Issue of *Science* (*1*). We were impelled by this article to make a brief study of the capital-letter abbreviations that have been used in signed articles that have been published in *Science* during the past 2½ years. For material, we used a card file that we have accumulated for editorial purposes.

In making this investigation, we sought to determine particularly what abbreviations have had more than one meaning, especially in different fields, and what meanings have had more than one abbreviation. In addition, we considered the meanings that individual letters have had as elements of abbreviations and the number of abbreviations that have never been explained. We found that the overall result is a startling hodgepodge.

Of the abbreviations that have had more than one meaning, the following may be cited as examples. BP has been used for "before the present," "blood pressure," and "boiling point." BT for "bathythermograph" and "blue tetrazolium." DMF for "dimethyl formamide" and "decayed, missing, and filled teeth." DNP for "dinitrophenyl" and "dinitrophenol." EA for "experimenter associated with the agent" (used in parapsychology) and "enzyme activity." H for "sorbitol" and "histidine" as well as for a well-known element. IDP for "inosine diphosphate" and "integrated data processing." PNH for "reduced pyridine nucleotide" and "paroxysmal nocturnal hemoglobinuria."

On the other hand, several different abbreviations have been used for one

The author is a member of the editorial staff of *Science*.

meaning. Thus *p*-chloromercuribenzoate has been abbreviated CMB, PCMB, pCMB, and *p*ClHgBA; thyroxin, T, TX, and THY; hydrocortisone, F, compound F, and HC; and deoxyribonuclease, DNase and DNAse.

In addition, there are mixed forms—one meaning with several different abbreviations, one or more of these abbreviations having been used for still another meaning. α-Naphthaleneacetic acid has been abbreviated NA, NAA, N2A, and ANA; but NA has also been used for "nicotinamide."

Our file of capital-letter abbreviations contains 485 cards in all. The 485 abbreviations have had at least 542 different meanings—we say "at least" because 109 appeared without any explanation, and almost all of the other 376 appeared in at least one article without any explanation. Of the 485, 272 were used in only one article each.

One author, having 11 compounds to discuss, simply symbolized them A, B, C, D, E, F, G, H, I, J, and K. Most authors attempted to abbreviate rather than to symbolize, but the resulting form was occasionally a mixture: AMP was used in four articles for "adenosine monophosphate," in two for "adenylic acid" (which was abbreviated AA in two other articles), and was not explained in two articles. Chemical symbols for the elements were also used as parts of abbreviations, but without consistency. Aside from the example of *p*-chloromercuribenzoate that has already been cited, tetrapotassium pyrophosphate has been abbreviated TKPP and TPPP, and tetrasodium pyrophosphate TSPP. One author used TKPP and TSPP. TNaPP has not been used, but we may see it yet.

Among the 109 abbreviations that were not explained by any of the authors who used them were most of those in what we call the "dose" series: AD_{50}, ED_{50}, EI_{50}, ID_{50}, LD_{50}, LD-50, $LD_{42}{}^{30}$, $LD_{100/30}$, MLD, TC_{50}, TC 50, TCD, TCD_{50}, $TCID_{50}$, TD_{75}, and TI (therapeutic index, the ratio LD_{50}/AD_{50}) (TI has also been used to mean "total iodine"). Another series whose members usually appear without explanation, the "I-with-one-other-letter" series, is composed of ID (inside diameter and infective dose), IM (intramuscular and imidazole), IP (intraperitoneal and ipomeamarone), IQ (intelligence quotient), IR (infrared), IU (international unit), and IV (intravenous). In this particular series a further complication arises because many of the members are also abbreviated with lower-case letters, both with and without periods. A third series of seldom-explained abbreviations is the "EG" series: ECG (electrocardiogram and electrocorticogram), EEG, EKG, and ERG.

Table 1. Meanings of the letter *A* in abbreviations that have been used in *Science* during the past 2½ years.

Meanings in position 1	Meanings in position 2	Meanings in position 3	Meanings common to two or more positions
acridine	absorbed	absorption	acet-
acute	agent	alanine	acid
adenoidal	agglutinating	albumin	activating
adenylic	allantoic	allyl	adenine
adrenal	area	alternating	adenosine
alcohol	aspartic	amylose	amino-
alpha	avoidance		ammonium
androsterone	azo		anti-
anesthetic			antigen
animal			association
auto-			

Two abbreviations conflict with our own office jargon: SMO has been used for we know not what, but we use it to mean *The Scientific Monthly*. TP has been used for "titration-passage technique," "triphosphate," and "tryptophan peroxidase"; to us, it means "Report" (in the old format of *Science*, what are now called "Reports" were known as "Technical Papers," and we have not updated our shorthand).

When we considered the meanings that various letters have had as individual elements within the abbreviations, we found that confusion was compounded. In the three positions of three-element abbreviations, the letter *A* alone had numerous meanings, as follows: in first position, 19 meanings with three others that were not explained; in second position, 16 meanings with one other not explained; in third position, 12 meanings with two others not explained. The various meanings of *A* in these positions are summarized in Table 1, where meanings that appeared in more than one position are listed in a separate column.

Several of the abbreviations that have been used, such as TNT, DDT, ACTH, TV, and IQ, have become a part of the language and are perhaps better known than their parent expressions. Certain others, such as ADP and ATP (adenosine di- and triphosphate), DPN and TPN (di- and triphosphopyridine nucleotide), and DNA and RNA (deoxyribonucleic acid and ribonucleic acid), are well known, at least in biochemistry and related fields. But even such a well-known abbreviation as ADP has had different meanings: "adenosine diphosphate," "automatic data processing," and "ammonium dihydrogen phosphate."

Moreover, we have found the ambiguities listed here by considering only the abbreviations that have been used in signed articles. We do not doubt that we could find more conflicts by including abbreviations for government agencies, societies, strains of mice and viruses, universities, models of instruments, and nuclear reactors in the list. The multiple meanings of MIT (Massachusetts Institute of Technology and monoiodotyrosine) (*1*) and AA (adenylic acid and Alcoholics Anonymous) come to mind immediately.

A few abbreviations that did not appear often suggest ways in which the list of ambiguities could be extended still further. For example, CHR (*Cercarienhüllen Reaktion*) suggests that we consider German-language terms. RP (serum *lacking* in properdin) suggests almost frightening possibilities: How many of the 109 unexplained abbreviations denote *absence of* something rather than *presence of* something? N2A (one of several abbreviations used for α-naphthaleneacetic acid) suggests that abbreviations could be abbreviated by using number coefficients: AAAS (American Association for the Advancement of Science) would become 3AS, as, indeed, it already has in the spoken language.

Most of the abbreviations are not sufficiently redundant to carry their meaning despite a typographic error. Thus, despite proof-reading in the editorial office and by the authors, RNA (ribonucleic acid) once became PNA in the published version (PNA has been used to mean *any* nucleic acid); DPO (diphenyloxazole) became PPO, which was one of two abbreviations used for "pleuropneumonialike organisms"; and UV (ultraviolet) became IV (intravenous). A simple transposition would change UDPGla (uridine diphosphoglucosamine) into UDPGal (uridine diphosphogalactose), but fortunately this has not yet happened.

The meaning of nearly every one of the 109 unexplained abbreviations could be ascertained by a general reader, but sometimes only by study of the context.

Presumably readers from the same field of science would recognize the intended meaning instantly, but the main point is that those in other fields might have to study.

We feel that we should make more effort to eliminate abbreviations from the texts of "Articles" and "Reports," particularly abbreviations that appear only occasionally. Of course, it is necessary to use them in equations and reaction schemes, and perhaps in the texts of articles when a long chemical name is used again and again.

However, as has been suggested before (*1*), judicious use of pronouns, and care on the part of authors, might reduce the number of different abbreviations used in any one article, as well as the total number of all abbreviations. The saving of space obtained by use of abbreviations is hardly worth the restriction of understanding, and only a few of these abbreviations can become any more than what they are, laboratory and notebook shorthand.

Reference

1. "Use and abuse of English in science," *Science* 123, 720 (1956). This article was an excerpt from the leading article in *Nature* for 5 Nov. 1955.

Scientific Approach to Ethics

Anatol Rapoport

Opinions on the relation of science to ethics are usually strong ones and are often arrived at not so much by investigation of such relations as through conviction about what these relations ought to be. These opinions tend to divide those concerned with such matters into two camps. In one, the feeling runs high that science is ethically neutral, that it is concerned with what is and not with what ought to be. This view is usually stated categorically and enjoys a high degree of agreement among its adherents. No such unanimity prevails in the other camp, where it is felt that connections do exist between science and ethics. This is not surprising. Those who deny that such connections exist can readily agree, for once something is declared to be nonexistent there is nothing further to be said about it. But if something is said to exist, we wish to say more about it, and the more one says, the more controversial one's opinions are likely to be.

To preserve the lines of communication in such a discussion, it may help to agree, first of all, on what is meant by an ethics or an ethical system. It seems to me that in every ethics there is involved a set of choices and a set of rules governing the making of the choices, with a proviso, however, that these rules are not entirely instrumental in the pursuit of an explicit, unambiguously defined goal. This last restriction serves to differentiate an ethics from a strategy. For in a strategy, too, one has a set of choices and a set of rules for making choices, but the goal is explicit and unambiguous. Thus, the principles governing the choices of plays in a game of bridge are principles of strategy. But there is also an ethics which excludes acts defined as cheating. The "ethics" of bridge can also be said to have a goal—for example, the assurance that the players will continue to respect one another and will continue to play—but this goal is certainly not nearly so explicit and unambiguous as the goal of winning.

In this sense, we may speak of various professional ethics as distinguished from the "strategy" or the technique of the profession. There is an ethics in the legal and the medical professions. There is an ethics in the business community, in the military, and in the underworld.

Often strategy and ethics are not easily distinguishable. For example, the saying "honesty is the best policy" indicates that one of the ethical principles of business is seen to be also a strategic principle. On the other hand, ethics and strategy may conflict. This is dramatically shown in the frequent violations of the so-called "rules of warfare."

We note, next, that scientific practice also has an ethics, and, characteristically, that the ethical principles of scientific practice are intimately intertwined with strategic principles. The scientist is guided by certain rules of evidence in his definition of what is true. Furthermore, the scientist binds himself to hold and profess views (at least in regard to matters subject to scientific investigation) which he must acknowledge to be true according to those rules of evidence. Since these rules are remarkably consistent and remarkably easy to apply (compared with other rules that govern ethical decisions), the ideal of universal agreement on matters within the jurisdiction of science seems attainable in practice. Therefore, the scientist (if he is consistent) is bound to strive for universal agreement among scientists on these matters. Moreover, the agreement is to be attained neither by coercion nor by force of personal appeal but by examination of evidence alone. In other words, if "conversion" of an opponent to one's point of view is a desideratum (such desiderata are really not included in the ethics of scientific practice but are nevertheless carried over into scientific practice from other areas), the satisfaction of such a conversion in scientific matters is complete only if the change of view comes independently of any pressure other than the weight of evidence.

Thus, even our characteristically human tendency of wishing that others thought and acted as we do becomes modified in scientific practice, because coercive measures toward those ends are pointless. Unless the conversion is made by force of evidence, it is an empty victory to achieve it.

These, then, are the ethical principles inherent in scientific practice: the conviction that there exists objective truth; that there exist rules of evidence for discovering it; that, on the basis of this objective truth, unanimity is possible and desirable; and that unanimity must be achieved by independent arrivals at convictions—that is, by examination of evidence, not through coercion, personal argument, or appeal to authority.

I submit that here is a respectable chunk of an ethical system. The question before us is whether this is, characteristically, a "professional" ethical system on a par with other such systems, like those that govern the medical, legal, military, and criminal professions, or whether there is something unique about the ethics of scientific practice which makes it a particularly suitable basis for a more general system.

Dr. Rapoport is a member of the Mental Health Research Institute of the University of Michigan.

This article is based on a paper presented on 27 Dec. 1956 at the annual meeting of the AAAS, in New York.

Before we attempt to answer this question, let us note that many professional ethical systems tend to become more than codes of conduct governing restricted professional groups. For one thing, a given culture or subculture may be ruled or dominated by some professional group, with the result that the code of that group becomes a model for an ethical system in that culture. Rather vivid examples come to mind in the case of warlike cultures and predominantly business cultures. Indeed, it appears that the ethical system prevailing in the United States is predominantly a reflection of the code of conduct prescribed for its members by the business community.

But if this be the case—namely, that codes of professional conduct tend to become ethical systems in cultures dominated by the respective professions—cannot one argue that the generalization of the ethics of scientific practice to a general code of conduct, should it occur, would be merely a case of such domination, no different in principle from analogous domination by some other professional group, such as business, bureaucracy, or the military?

Here we come to the fundamental differences of opinion among those who hold that there exists a connection between science and ethics. There are those who hold the view that the code of conduct of the professional scientist does have ethical implications but that such "scientific" ethics is confined to the behavior of the scientist *qua* scientist and should not influence his behavior in his other roles. There are those who maintain that ethics derived from scientific behavior may, indeed, become the ethical basis of conduct of a whole culture but that this basis is, in principle, no different from other possible bases. And there is the extreme view (to which I subscribe) that the ethical system derived from scientific behavior is qualitatively different from other ethical systems—is, indeed, a "superior" ethical system in a sense which I shall presently define.

This "superiority" of scientific ethics is extremely difficult to defend, because superiority can be established only on the basis of criteria, and whatever criteria one chooses are vulnerable to the charge of being selected in order to prove the superiority which is claimed. Thus it was easy enough for Galton to claim superiority of Englishmen over African Negroes—he set up the criteria of comparison. It is equally easy for a Brahman to prove the superiority of Hindu culture over the European, and so on. Obviously, such ethnocentric traps must be avoided. We should, however, mention in passing that the very idea that one may be caught in the trap of one's own provincialism can be entertained only from the vantage point of the scientific outlook; only this outlook allows an objective comparison of several systems. Such comparison is possible only by way of analysis, and analysis is, by definition, the core of scientific inquiry. Therein lies the qualitative difference between the scientific outlook and others. The scientific outlook is the only one capable of self-examination; it is the only one that raises questions concerning its own assertions and methods of inquiry; the only one that is able to uncover provincial biases which govern our convictions and thus at least give us the opportunity to avoid such biases.

Science, like all other systems of thought, seeks answers to questions which men hold to be of importance. But whereas, in other outlooks, answers are accepted that harmonize with particular world-views peculiar to different cultural complexes, science seeks answers which are reducible to *everyone's* experience. These cannot be answers based on esoteric or mystic experience, because such experience can be common to, at most, a few. These cannot be answers based on unquestioned authority, because such authority remains unquestioned only to the extent that experiences which could lead to questioning are excluded. These cannot be answers derived from narrowly limited experience, because science puts no limits on experience. In short, the irreducible answers to scientific questions are answers linked to those irreducible experiences which can, potentially, be shared by all mankind. The situation is most marked in the physical sciences, whose results are sometimes held to be trivial by humanists, mystics, philosophers, and others, because the assertions of these sciences are about nothing but pointer readings and so do not really touch matters of profound concern to man. Trivial or not, pointer readings are unquestionably matters of universal agreement. The concepts "larger than," "later than," "between," or "three" are the same for the Norwegian and the Hottentot. There may be other bases of universal agreement, on elementary principles of kindness, beauty, or the desirability of survival, but none of these supposes common denominators of human values that are completely unambiguous bases of communication or of human communality. For the scientist, the act of communication (the utilization of one nervous system by another without detriment to either) is the basic ethical act. And it is only on the most trivial level (the level of "extensional facts" or pointer readings) that we may be sure of perfect communication. Science, then, is the only human activity which taps the really universal communality of human experience at its roots. The remarkable thing is that the tremendous edifice of knowledge which is being created on these foundations is shared by all who participate in its creation, to the same complete degree of communality.

No matter how "Westernized" a non-Westerner may become, it is doubtful to what extent he accepts Western "values" and rejects his own. If he rejects these completely, there is always the question of what conflicts may accompany the transformation. But the acceptance of the scientific outlook in the area of actual investigation seems to be complete, regardless of the cultural background, and there seems to be little evidence of conflict once the vantage point of scientific outlook is reached. In other words, the conversion to the scientific outlook is almost universally irreversible. It is possible for someone who believes in a magical basis of a phenomenon to reject this belief in favor of a scientific explanation, but the reverse change of view hardly ever occurs. Nor can it be argued that such unidirectional conversions result from domination by the bearer of the scientific outlook—namely, Western civilization. If that were the case, certainly conversion to Christianity (which has been energetically pursued) would have been much more universal than conversion to the scientific outlook. Not only is this not the case, but, even in the struggle within Western civilization between the religious and the scientific views on the nature of the physical and biological world, science has been unequivocally victorious.

Contrary to prevailing opinion, I should like to defend the view that science is not, like industrial capitalism, Christianity, or racism, simply another culture-bound product of Western civilization, although doubtless science has been given its greatest impetus by certain developments peculiar to Western culture. Typical of ordinary components of culture is their functional interrelation. Even if we discount the extreme position of functionalist anthropology, which views every culture as a perfectly harmonious whole, still it must be admitted that, by and large, the trend toward harmony persists. Beliefs, practices, and institutions tend to be accepted or rejected (unless, of course, they are imposed by force) according to whether they tend to support or to disrupt the cultural complex and its supporting world-view.

Science seems to be a notable exception. Science has had a disruptive influence on the European social order: first, it destroyed feudalism and its support, the spiritual hegemony of the established Church; now it is continuing to disrupt it by discrediting the convictions necessary for the maintenance of colonialism,

of nationalism, of *laissez-faire* capitalism, and of the authoritarian family structure. It is true that, for 300 years, science made possible the domination of the world by Western civilization. But now the trend is reversed, and it is again science which is making this domination an anachronism.

The ethics of Western culture—that is, the conventionally accepted criteria of right and wrong—are as vulnerable to the encroachment of the scientific outlook as any other ethical system. This is why it is a mistake to list science along with the other provincialisms of the West. Typically, a Westerner believes, or has believed until his beliefs were challenged by science, that Westerners should dominate the non-Westerners; that it is in the interest of national states to be more powerful than their neighbors; that private property is forever sacrosanct; that a man is not properly dressed unless he wears a noose around his neck; that the character of a child can be improved by beatings. Much of the so-called "moral crisis" in the Western world is traceable to the undermining of some of the most tenaciously held beliefs by the inroads of scientific views.

In view of this disruptive influence of science (disruptive in the sense of undermining holistic cultural outlooks), how are we to account for the accelerating spread of the scientific outlook? An obvious answer points to the bait of technology. Science makes technology; technology is power; men seek power and, therefore, tolerate science. I would like to argue, however, that there is another reason—namely, the ethical appeal of the scientific outlook—which marks science as not simply another of the "white man's ways" but as something *sui generis*.

There seems to be something universally satisfying about the scientific view, at least as it affects man's outlook on his environment. Once the vantage point of this view is attained, other views seem impoverished, provincial, naive. There is no going back.

I am aware that this claim had previously been made for different religions in their expansionist phase. There may have been some justification for those claims in the sense that the acceptance of those religions (particularly Christianity, Buddhism, Islam) carried with it the exhilarating feeling of revelation. Yet there turned out to be several of these so-called "great religions," and, in spite of the fact that they seem to have similar ethical cores, their theologies are "incompatible" or, rather, have no basis of comparison, so that if one adheres to a great religion, one is usually either a Buddhist or a Moslem or a Jew or a Christian, or whatever, for no explainable reason, except the accident of first contacts. Science alone has succeeded in constructing a really unified philosophy, and this is because scientific philosophy is not just another philosophy—that is, another poetically harmonious system of metaphors. Scientific philosophy makes possible the examination and comparison of *philosophies*, whether as systems of logical constructs or, more characteristically, as instances of human behavior.

The bid of scientific ethics for universal acceptance rests on the claim of science to be the first instance of a universal point of view about man's environment and, moreover, a point of view not imposed by coercion or even by power of persuasion or dramatic, personal example but by its inherent, universal appeal to universal human experience, through being rooted in reliable knowledge.

Ethics, however, is not complete unless it includes man's outlook on himself as well as on his environment. The extension from scientific outlook to scientific ethics is simply the extension of the subject matter of scientific investigation from man's environment to man himself. It is, therefore, with the consequences of this extension that we are concerned.

At this point it is proper to review the divergences in the opinions of those who hold that there is a connection between science and ethics, aside from the difference of opinion on the relevance of scientific professional ethics to general ethics. Some confine the connection to the possibility of studying various existing ethical systems by the objective methods of science. Others go further and say that ethical systems, typically, contain not only ends but also convictions or tacit assumptions concerning the most effective means to reach those ends. Admitting that ends cannot be chosen by scientific inquiry, they maintain that scientific methods are applicable to the search for effective means. For example, the elimination of conflict within a society may be an end in two different ethical systems. In one, the end may be pursued by strict apportionment of status, with attached privileges and responsibilities; in another, by an approach to an egalitarian ideal. Some would differentiate between the end and the means and maintain that the former is chosen arbitrarily, while the latter could be prescribed by a scientific investigation which could, presumably, determine the efficacy of each course of action.

Both of these views, which attribute to science only a limited role in relation to ethics, assume the possibility of sharp division—in one case between an inquiry into what *is* and a conviction about what ought to be; in the other, between means pursued and goals desired.

The third view—again an extreme one, which I am defending here—is that not only is science related to ethics but that science is becoming a determinant of ethics; that is, the ethics of science must become *the* ethics of humanity. I hold this view because I do not believe that one can separate either knowledge of what is from desires of what ought to be, or means from ends. To be sure, such separation can appear temporarily to be effective. The anthropologist can, for some time, describe and attain insight into a variety of ethical systems, at the same time holding on to his own. The physicist can, for a time, use scientifically ethical means (that is, pursuit of objective truth) in the service of scientifically unethical goals (for example, imposition of coercion by war). But these positions are unstable and are doomed to extinction. It is impossible, in the long run, to hold provincial views while pursuing knowledge. Comparative ethics or the dispassionate examination of means to attain arbitrarily chosen goals are not innocent pursuits. On the contrary, they make a serious impact on the investigator and on the society which he serves. They force the firing of questions aimed at the very foundations of existing ethical systems, foundations which can remain intact only if no questions are fired at them. I know of no existing culture or ethical system (as these are conventionally understood) which does not, to some degree at least, rest on a delusion. This is in no way surprising in view of the fact that every system of knowledge, including scientific knowledge, rests ultimately on some fictions. Scientific knowledge, however, is by definition that knowledge which can weather the shattering of its fictions. It is in this sense that scientific knowledge is unique. Alone among all cognitive systems, the scientific cognitive system does not shrink from the shattering of its own foundations, and when this happens, it becomes, paradoxically, more organized rather than disorganized and demoralized.

It is, therefore, possible to hope that the same "ultrastability" will characterize the ethical system derived from scientific practice. Certainly, this ethical system, like others, must rest on fictions, but the fictions are not sacrosanct. They can be shattered without a resulting disorganization of the system.

What are the elements of scientific ethics? Little can be said about them, because this ethic has not yet permeated human communities sufficiently deeply and so is not a result of actual practice. Certainly, the pursuit of truth "wherever it may lead" is a paramount goal. It is tempting to suppose that all other ethical principles will be derivatives of this goal. It is tempting to sup-

pose that a great many of these principles will coincide with those of the ethical systems of the great religions, dignity and brotherhood of man, but only as derivatives, the condition of dignity and brotherhood being most conducive to the pursuit of truth. The hope is that those activities of man which are condemned in most ethical systems but rationalized on other than ethical grounds will disappear, because their rationalizations will become untenable in the light of scientific inquiry. The same applies to quasi-ethical systems such as totalitarian ideologies and the highly specialized codes of conduct of small isolated communities. All these rest either on coercion or on exclusion of experience. Both coercion and exclusion of experience can be maintained, in the long run, only by the maintenance of sacrosanct fictions. Therefore, all coercive and provincial ethical systems depend critically on the fictions which support them. They collapse when the fictions are shattered, and their fictions are easily shattered once even the primitive elements of scientific inquiry are directed against them.

To summarize, it is possible to approach ethics scientifically in a stronger sense than simply by scientifically investigating existing ethical systems or by offering an analysis of the efficacy of means, employed to pursue given ends. The mixing of science and ethics guarantees that science will play far more than a descriptive or an instrumental role. This is so because science brings with it its own (for the time being, only "professional") ethics. This ethics, however, can be generalized to a complete ethical system which has a viability far greater than the existing ones. This greater viability is the result of the same properties that are possessed by scientific knowledge. Although this knowledge has always rested on fictions, it did not deteriorate when the fictional foundations were repeatedly shattered by reorganizations of knowledge but, on the contrary, gained from each such crisis. There is no sharp distinction between scientific outlook and scientific ethics. Both eschew authority—that is, coercion in any form—and probably for this reason are irresistibly attractive as means of liberating man from the bonds which, in his ignorance, fear, and ethnocentrism, he has imposed on himself.

Classifying and Indexing for the Special Library

Saul Herner and Robert S. Meyer

Classification is one of the most universally applied and least appreciated methods by which scientists and librarians organize and obtain information. Classification pervades practically every selection process in human experience, whether the thing being selected is an item in a supermarket or a book in a library. The primary factors that dictate the way that things are classified are physical necessity, economic necessity, and intellectual habit.

In a supermarket, the housewife shopping for a vegetable for her family's dinner goes to the vegetable department. Here, she finds an array of vegetables of various shapes, colors, and flavors. The vegetable department is an example of classification based on physical, economic, and intellectual habit factors. The odd shapes and quantities of vegetables, their perishability, and the fact that the housewife thinks of vegetables as a single concept or class of things necessitate their being displayed together or close to one another in the market. One or more of the same three factors furnishes the basis for the existence and location of all other classes of merchandise in the supermarket.

Turning to libraries, we find the same three factors dictating the manner in which books and other publications are arranged on the shelves. For the majority of libraries, the primary factor is the presumed intellectual habit of the library user and the librarian. Books are arranged on the shelves according to subject categories that are a reflection of logical or traditional relationships. Ideally, these relationships will coincide with the subject relationships that exist in the mind of the user.

In addition, there will be an index or catalog with multiple subject entries to direct the user to the part or parts of the collection containing publications on a given subject. The library uses this device to correct for the fact that a book may deal with a number of subjects but can be in only one place at a time. Ideally, the subject headings or entries in the catalog will be in the language of the users and will serve also as a key to the classification. In addition, they will be consistent and mutually exclusive.

Thus, there is a useful artifact, an alphabetical index in the language of the user, superimposed on a physical arrangement of published materials that is a reflection of the user's intellectual habits and associations. This is an ideal situation, in which the seeker of information can choose between going to the index and then to the books or going directly to the books.

Many librarians and documentalists consider it inefficient to go directly to the books without first consulting the card catalog. The logic behind this is that the library card catalog, through its multiple subject entries, can tell the searcher *all* the publications in a library that treat of a given subject, whether in a major or minor way, whereas by going directly to the shelves the searcher is likely to find only those that treat of a subject in a major way, if indeed he finds anything at all. Nevertheless, most specialist-users of the library go directly to the books when they can, and they seem to find this arrangement satisfactory. When they use the card catalog at all, they generally use it to locate items they already know about.

This rather informal approach to the literature and the limited use of the card catalog probably stem from the fact that the professional worker in a field is not likely, except on rare occasions, to want to know everything on a given subject. He is merely looking for something to supplement or help recall what he already knows. Classification favors this approach by laying before the seeker of information a group of related publications whose major content is the subject in which he is interested.

Mr. Herner and Mr. Meyer are partners in Herner, Meyer and Company, Washington, D.C., consultants who conduct research in library planning, organize and conduct informational surveys, and design information systems.

Defects of Existing Systems

In recent years, classification has fallen in the general esteem for various reasons. One reason is related to the factors of economics and physical necessity. Some of our large libraries—the John Crerar Public Library and the New York Public Library, to name two—have been forced by the increasing size of their collections and the rising cost of storage space to discard classified arrangements of their books in favor of arrangements based on the chronological order in which the books are received and processed. This results in a great saving, since it eliminates the need for leaving spaces on the shelves to allow for new books in the various subject classes. By this method, the books are packed together tightly, and additions are made at the end. The obvious shortcoming of this arrangement is that the books are arranged in random order, and the possibility of browsing is practically eliminated. However, in the case of the John Crerar and New York Public libraries, this is no real loss, since neither library permits public access to the bookstacks anyway.

Another reason for the decline in usefulness of classification systems is the fact that those presently in use are inefficient in a number of rather serious respects. Unlike our ideal classification system, the average system now in use does not reflect the logical and traditional relationships that exist in the minds of the users. Potentially useful books are often overlooked because they are shelved among books that are not related in the mind of the library user.

Another shortcoming of existing classification systems is the inadequate definition of their subject classes. This fault results in the classifier's being unable to decide which of a number of similar classes a book rightfully belongs in. It also results, sometimes, in the classifier's discovering that there is *no* category in the classification to accommodate the subject of a given book. What generally happens in such cases is that the classifier has the choice of forcing the book into the subject class that comes closest to fitting its subject or of establishing a new subject class. Confusion is compounded when the library user is forced to duplicate the perplexities of the classifier in trying to find out in which of several equally logical places the book is actually resting.

In addition to their other errors of omission, the classification systems presently in use lack the flexibility to assimilate new doctrines and new developments on every level of generality. This is probably the most important reason for the square-peg-in-the-round-hole dilemma. The presence of a rigid hierarchy and the lack of a simple means of altering or expanding its existing parts greatly diminish the current usefulness of the average classification system. This is particularly serious in science and technology, where the growth of new doctrines, new developments, new subjects, and new subject relationships is truly prodigious.

However, the criticisms we have leveled are criticisms of specific classification systems and cannot be validly applied to the entire concept of classification. To condemn library classification as a whole, and to discard it completely because some classification systems are inadequate, is to rob the scholar unjustly of one of his most valuable tools in his use of books.

Causes of the Defects

The inadequacy of present-day library classification systems is the result, primarily, of their attempt at universality. There are really only three systems that are broadly recognized and used at the present time. These are the Dewey Decimal classification, the Library of Congress classification, and the Universal Decimal classification, which is actually an extension of the Dewey Decimal classification.

All of these systems have in common the fact that they are designed for libraries where the use made of the literature is extremely broad. The classification systems reflect this breadth of use by attempting to categorize every possible subject from every possible viewpoint. In any such situation there will naturally arise difficult problems of selection for the cataloger, particularly if the subjects and viewpoints are not clearly demarcated. This will give rise to inconsistencies in cataloging, which are bound to stymie the library user.

Another cause of the inadequacy of the existing classification systems is the fact that they are generally keyed in their design to a body of knowledge rather than to a body of literature containing this knowledge. This results in a failure of these systems to reflect the growth and subject content of the literature. In the case of the Library of Congress classification, the system is based on a specific collection, but this collection is so broad and is categorized from so many viewpoints that its effectiveness and meaning for the specialized library and specialist-user are seriously diminished.

In actual practice, it is difficult if not impossible to apply general classifications to specialized bodies of literature. In most instances where this is attempted, refinements of one sort or another are necessary. In one sense, the general classification is too detailed for use in a specialized collection, because it attempts to classify all subjects from all viewpoints. The library containing a relatively narrow collection of literature must obviously treat it from the viewpoint of the specialized group that is to use it.

In another sense, the general classification is too lacking in detail for the specialized collection. In attempting to encompass all the world's knowledge, the designer of the general classification is forced to treat any given phase of this knowledge rather shallowly. This gives rise to the problem, often encountered in the specialized library, of having available a relatively small number of subject classes into which a relatively large number of publications must be categorized. The necessary solution is to subdivide the available subject classes in some fashion. Thus, without formally setting out to do so, the librarian of the specialized collection, in attempting to adapt a general classification to the needs of his library, is actually designing his own classification system.

Faced with the difficulties of applying general classification systems to specialized collections of literature, many librarians and documentalists have discarded classification altogether and have relied exclusively on various forms of indexing. Where such indexing systems have been in the language of the users, and where they have been consistent in their terminology and meanings, they have been quite useful. They have fallen down when they have attempted to include indexing terms or headings for every conceivable shade and aspect of every pertinent subject. This breadth of coverage often results in a fractionation of subjects which makes the index entries far more specific than they are in the searcher's mind. This complicates the cataloging and retrieval processes.

The retrieval aspect of the problem is perhaps illustrated by the recent experience of one of us, who, in the course of a cataloging assignment, sent to the Library of Congress for a set of printed catalog cards for a book entitled *Business Success Handbook; Your Complete Guide to Executive Growth.* When he received the cards, he looked to see under what subjects the Library of Congress had indexed the book. He found that it was indexed under only one subject: Success! Fortunately, it was classified in a subject class for business and would have been shelved and found among the books on that subject. In this way it would be possible to find a book despite the inept terminology that sometimes characterizes index entries.

In many of the more recently developed indexing systems, this alternate retrieval method is not possible, because they are keyed to physical arrangements that do not reflect subject relationships. As a result, a person doing a subject

search in the library is forced to use the catalog or index whether or not he considers it adequate. Thus, the user of the literature becomes the servant of the system by which it is indexed. This is obviously a topsy-turvy situation.

The basic shortcoming of most of the classification and indexing systems presently in use is the fact that they do not truly reflect the needs and approaches of their users. In addition, where classification and indexing systems are used in conjunction with each other, they are very often not coordinated in context and terminology, with the result that the classification views the literature in one way and the index views it in quite another way.

Tailor-Made Classifications

For the past several years, we have been concerned with the development of classification systems, and of indexes to these systems, which are truly reflective of the language, viewpoints, and requirements of their users. A basic proposition in the design of such tailor-made systems is that they be constructed for a fixed group and not for a general public. The systems presently under development are designed for groups of scientists or for other relatively specialized groups of individuals whose literature needs and approaches are similar.

At this writing, two such systems have been designed and installed, one in the library of a trade association in the construction field, and the other in the research library of a firm manufacturing a line of surface cleaners and related products. A third system, designed for the organization of literature on atomic energy and related subjects, is now under development. This system is actually experimental in nature. It is being developed, first, as a basis for testing the efficacy of tailor-made classification and indexing systems for their own sake and, second, as a basis for comparing such systems with other systems presently in use. This work is supported, in part, by a grant from the National Science Foundation.

There are seven basic requirements which must be met in the custom design of classification and indexing systems. Liberal mention has already been made of the first of these requirements: (i) The subject classes and the terms used to define these classes must be directly reflective of the viewpoints and language of the users. (ii) The system must reflect the actual literature to be organized as well as the actual purposes for which this literature is used. (iii) All classes and descriptive terms must be mutually exclusive in their content and meanings. True mutual exclusiveness is a difficult, if not impossible, thing to obtain in nature, but, in a system designed for a specific population and a specific body of literature, it can be accomplished by means of delimiting labels which define clearly the scope and content of each class and descriptive term. (iv) The number of documents within classes must be approximately equal and of such magnitude as to permit ready perusal. (v) The system must be readily and logically expandable to permit the assimilation of new documents and new subjects. (vi) The notation used to identify classes must be constant in its number of characters and otherwise simple to transmit and recognize. (vii) The classification must be constructed by means of groupings of like subjects, and any hierarchical relationships designed into the system must reflect the intellectual habits and preferences of the users rather than any philosophic laws of nature.

On a given level of generality, subjects are usually coordinate in value. It really does not matter to the person who is interested in automobile wheels whether books on tire rims are placed before or after books on tires, on the shelf. The important thing is that they be located close to one another and that the library user be able to ascertain this location with a minimum of difficulty.

There are several ways in which the requirements, viewpoints, and technical language preferences of the user population can be determined. One method is by means of detailed interviews with a cross section of the users. Another method is through observations of the users' day-to-day activities and problems over a representative period of time. A third method is through the analysis of representative samples of the writings of the users, when such writings are available. A fourth method is through the analysis of a cross section of reference questions which actually arise from the activities of the user group.

The method used in a given case is a function of the size and character of the user-audience being studied. When the group involved is located within the confines of a single organization, the first two methods—interviews or on-the-spot observations of activities—can be applied. When the user-group is ill-defined or physically scattered, the latter two methods—analysis of writings or analysis of reference inquiries—can be used. In some instances, a combination of the foregoing methods is used.

Design of Specific Systems

In the construction of the classification and indexing system for atomic energy literature, the reference inquiry analysis method is being used. Actual reference questions received by libraries and reference centers in atomic energy installations all over the country are being collected and analyzed for subject content and terminology. At this writing, approximately 5000 questions have been received and analyzed. Upon the completion of this phase of the project, a total of approximately 10,000 reference questions will have been collected and analyzed.

Sorted into categories based on similarity of content, these questions will constitute a crude classification system. At this stage, a cross section of the literature to be organized will be classified in terms of the categories established in the crude classification system. This furnishes a guide to the probable number of documents that will fall into the various subject categories.

The pilot classification process actually has three functions: (i) it insures that the classification truly reflects the literature it seeks to organize; (ii) it serves as the basis for the development of subjects on lower levels of generality; (iii) it furnishes a means of ascertaining the number of documents that will fall into the various subject classes. Counts are made at this phase to find out what classes are likely to contain so few documents that they should be combined with closely related classes. At the same time, counts are made to determine which classes are likely to be so overcrowded with documents that subdivision into smaller classes will be necessary. The foregoing operations constitute a "smoothing" of the subject classes. In the course of this "smoothing," criteria are established to serve as a basis for subdivision, where this is indicated.

The final stage in the process is the assigning of discrete numbers to identify each of the classes on the several levels of generality and the establishment of evenly distributed, unassigned classes to allow for ready assimilation of new subjects or for unanticipated growth in the number of documents in any given subject. The number of assigned and unassigned categories and the number of levels of generality will depend on the magnitude of the literature at the time the classification system is designed and on the rate of growth of the field and its literature.

In the case of the atomic-energy literature, there exist approximately 20,000 documents, and the rate of growth is of the order of 2000 documents a year. To accommodate such a body of literature and such a rate of growth, a total of 3000 subject classes will be utilized. At the outset, 1536 of the available 3000 subject classes will be used, leaving a total of 1464 unassigned for future expansion. These figures are based on an allowance of an average of about 12 to 15 documents per class.

In actual practice, each of the basic subject classes will constitute a fourth level of generality. Therefore, for con-

venience, the basic subject classes are termed subclasses. In this context, there will be a total of 3000 subclasses, 300 classes, 30 superclasses, and three major subject categories. Every fifth superclass, class, and subclass will be unassigned. By this means, allowance is made for expansion throughout the classification and at every level of generality.

Structurally, once the pilot classification process is completed, the system is built from the bottom up. Subclasses will be combined to form classes; classes will be put together to form superclasses; and superclasses will be combined to form major subject categories.

All subclasses, classes, superclasses, and major subject categories will be identified by four-digit numbers. Thus, the classification will take the following form:

1000–major subject category
  1100–superclass
  1200–superclass
  1300–superclass
  1400–superclass (unassigned)
  1500–superclass
  etc.
  1100–superclass
    1110–class
    1120–class
    1130–class
    1140–class (unassigned)
    1150–class
    etc.
    1110–class
      1111–subclass
      1112–subclass
      1113–subclass
      1114–subclass (unassigned)
      1115–subclass
      etc.

Superimposed on the various processes in the design of the classification is a feedback process which permits members of the user-population to edit and otherwise alter the system at every stage in its development. For this purpose, the equivalent of a consumer panel in marketing is utilized. This panel, which is carefully selected to represent the user-body, reviews the system in its various stages to insure that the arrangement of the classes and the language used to describe them truly reflects the user viewpoint. The editing by the user-panel also serves as a further means of establishing the best remedies for redundancy, when it is uncovered in the course of the pilot classification process. It also permits an evaluation of the subclasses and newly combined classes resulting from the pilot classification and literature count.

When the design of the classification is completed, all of the terms used in each of the subclasses, classes, superclasses, and major subject categories are arranged in a single alphabet to form a subject index to the system. Where indicated, cross-references to related terms are included in the index.

A second feature, which is installed at this point, is a set of "keys" to the subclasses, classes, superclasses, and major subject categories as well as a network of cross-indexing among related subjects. By means of the "keys," it becomes possible for the user of the classification to go from the broadest or most generic identification of his subject interest to the most specific identification in four simple stages. Thus, the user is afforded three means of approaching his subject: (i) the subject index, (ii) the "keys," and (iii) going directly to the shelves and browsing.

Advantages of the System

A basic advantage of the tailor-made classification and indexing system is its input and output speed. By actual time studies, the process of locating and writing down appropriate class numbers and indexing subjects for specific documents has been found to consume an average of 2 to 3 minutes. (These time studies were made with librarians who had no prior experience with this method of classification and no particular knowledge in the subject fields of the documents they were classifying.) This is several times faster than the time required for classification and indexing by conventional library procedures.

The speed of the system derives, basically, from the fact that it utilizes only established viewpoints and terminology. As a result, there are fewer subject headings and categories. Those headings and categories that *are* utilized in the system are mutually exclusive and reflect the most likely approach of the user to the literature. Thus, the choices available to the cataloger are sharply limited, and the classification and indexing processes are greatly simplified.

In much the same manner that it increases the input speed, the system increases the output speed. As has already been suggested, the library user, in tracking down a piece of published information, is forced to duplicate, in many respects, the thought processes of the person who cataloged and indexed it. Therefore, the simpler and more consistent the input processes, the simpler and more consistent the output.

Mechanical Searching Codes

Thus far we have been discussing the use of tailor-made classsification systems as a substitute for general classification systems in special libraries. There is another possible application of tailor-made systems which relates to the fact that such systems utilize consistent notations and discrete subject categories. This has to do with the use of such systems as bases for machine-searching codes.

One of the shortcomings of conventional classification systems as bases for such codes has been their inconsistency and the length of their notations. As a rule, in such systems, the more specific the subject category, the longer the subject class number. In punched-card information retrieval systems, where conventional classification systems are used, it is necessary to dedicate as much space on the card as is necessary to accommodate the largest number of digits used to denote any subject category. This results in a loss of valuable space on the card and a serious diminution in the flexibility of the system.

The same problem arises in systems where punched or magnetized-tape memories are used. In the case of devices using tape as a medium of storage, the problem is complicated by the fact that excessively complicated code notations necessitate the use of more code channels. This increases costs and slows the rate of search. Through the use of a constant, short notation, which reflects a carefully limited number of subject categories, the tailor-made classification may minimize these problems and make possible a more efficient use of mechanical searching devices.

Another feature that may make tailor-made systems readily amenable to mechanical searches is the discreteness of their subject categories. This discreteness of categorization makes possible a discreteness in coding which is not possible in systems where there are overlaps in subject categories. Where unique identification does not exist, there is always the danger of missing the target altogether or of getting a good deal of extraneous material along with the material that is actually wanted.

In addition to specific searches on the lowest level of generality, codes based on classification systems also permit mechanical searching devices to perform generic searches on a higher level of generality. This stems from the grouping of related terms in larger, more general categories. In coding systems that are not based on classification, generic searches are extremely difficult, since the relationships among the various concepts are not explicitly defined and are not incorporated in the code.

Areas for Future Consideration

Although the usefulness of tailor-made classification and indexing systems has been demonstrated through the design, installation, and day-to-day use of two such systems, there are still some questions that have to be answered. The first of these questions is that of the relative efficiency of such systems when they are compared in quantitative terms with existing systems. Factors to be considered in such comparisons are input costs, out-

put costs, and the relative effectiveness of the various systems in the performance of subject searches. The question of input costs of tailor-made systems versus conventional library systems has been fairly well settled. But the remaining elements of the overall question still remain unanswered.

As part of the study which is being performed under National Science Foundation auspices, an attempt is being made to find answers to these remaining elements of the question. Carefully designed experiments have been set up to test each of the comparative aspects of the new system against those of existing systems. These experiments have been designed to minimize biases resulting from differences in the mental and physical dexterity and doggedness of the persons using the systems as well as biases resulting from differences in the complexity and intellectual level of the literature that the systems are designed to organize. The tests will also take into account the effect of reference questions of varying levels of difficulty being put to the systems.

For the purposes of the present tests, a comparison will be made between the classification system which is being constructed for atomic energy literature and the indexing system now in use in most Atomic Energy Commission libraries.

Another question that still requires an answer is the comparative usefulness of tailor-made classifications as a basis for codes in mechanical searching systems. Although there is good theoretical evidence that tailor-made systems, their notations, and the mutual exclusiveness of their classes lend themselves to machine-encoding, this evidence has never been tested on a comparative basis in actual machines and real-life situations.

In order to furnish a basis for such tests, we have under construction a small, computerlike device which is capable of sorting and correlating literature references and various types of data. This machine will be amenable to codes based both on indexes and on classification systems. Thus, it will be useful for controlled, unbiased comparisons between tailor-made classifications and most other systems as coding media for mechanical searching devices.

It is very probable that there will develop, in the wake of the answers to the foregoing questions, many new questions that require answers. But, as new questions and new answers arise, they are bound to result in more and more effective means for making information available to the scientist and to other members of the scholarly community.

Science, Imagination, and Art

Norman Robert Campbell

Two criteria [may be used] to determine why a scientific proposition has value and what degree of value it has. . . . First, a proposition is valuable if truly universal assent can be obtained for it; second, it is valuable if its contemplation causes intellectual satisfaction to students of science. These two principles are to some extent contrary, and, if the test provided by each of them is applied to the same proposition, one might sometimes determine that the proposition is valuable and the other that it is not. For a student of science is a student of science in virtue of some difference between his intellectual constitution and that of the rest of mankind; if he finds intellectual satisfaction in a proposition it is almost certain that persons with different training and different interests can be found to whom it will give none; and on the other hand the mere fact that a proposition is approved by everyone, however different their modes of thought, will deprive it for him, not of course of all its value, but of that very special value which is the basis of the second principle. It is necessary therefore to examine the two principles rather more nearly and to determine exactly what part each of them plays in the establishment of scientific propositions. . . .

Everybody recognizes today that what I have called truth is an essential element of a scientific proposition and few, if any, will deny explicitly that what I have called meaning is also important. But it does not seem to me that facts which are universally admitted openly, or their implications, are always remembered when the most general and fundamental questions concerning science are raised. In such discussions attention is apt to be concentrated on the truth and the meaning is apt to be left out of sight.

The tendency is natural. The great advance or, more accurately, the first beginnings of scientific knowledge which took place in the 16th and 17th centuries were a consequence of the recognition of the possibility of scientific truth. To say that science must be based on experiment and observation is simply to say that it must satisfy the first principle of value, for it is only concerning the results of such experiment and observation that universal agreement of the kind which is characteristic of science can be obtained. It is the neglect of truth, the failure to test evidence according to the canons of modern science, the acceptance of well-attested fact, vague rumor, and the product of riotous imagination as equally valuable—it is the attitude of mind to which such things were possible which raises an insurmountable barrier between ourselves and the most enlightened of the ancients. That science should have meaning, they would have agreed readily; it was the doctrine that it should have truth which was strange to them. The ghost of Greek learning still stalks ruins not yet abandoned; it still disturbs timid minds and has still to be exorcised; the weapon of Galileo cannot be allowed to rust in its sheath, and while it has still to be used other dangers may be neglected.

However there is a more cogent reason why truth rather than meaning receives emphasis whenever any question is raised of the value of science or of its relation to other studies. Truth, it has been said, is a quality of which we may hope to convince others; it is a valuable quality because it is appreciated by everyone. And there is actually no doubt that scientific propositions have the kind of truth that is here attributed to them and that this truth has some value. Nobody disputes that truth, if they once agree to use that word in our sense; what they may dispute is whether or not it is misleading to call this quality truth and what is its value in comparison with that

Dr. Campbell is a noted British scientist who has made significant contributions to the philosophy of science. This article is reprinted from his *Physics: the Elements* (Cambridge University Press, London, 1920), chap. 8. By arrangement with Cambridge University Press, Dover Publications, New York, will issue a reprint of this book in May.

of other qualities. When therefore there has been any discussion of the value of science as a whole, its supporters have tended naturally, but, as I think, mistakenly, to insist on that element of science which everyone agrees is valuable and to attempt almost to conceal other elements concerning the value of which a difference of opinion is possible. They have tried to maintain that science is nothing but truth and indeed that it differs from other systems of thought in consisting of nothing but truth. Such were the motives which led, for instance, to Huxley's famous definition of science as "organized common sense," a phrase admirably suited for polemics and the obscuring of clear thinking. The word *organized* begs the question completely. It is not disputed that science, like all other forms of knowledge (*1*), has its basis in common sense, the agreed judgments of mankind, among which are those (relating to the external world) which have the truth characteristic of science. But the problem is how and by whom this common sense is to be organized, and whether the organization adopted by science introduces anything which does not share the truth of the things organized. . . .

Science and Imagination

But the fundamental reason why the meaning of science has been unduly neglected lies in the unwillingness of men of science themselves to recognize it. Their training in the methods necessary to attain truth has impressed on them so firmly that, in this part of their work, everything that can possibly be a matter of personal opinion must be excluded, that they are afraid to admit that anything can properly form part of their study which involves deliberate, though often unconscious, choice. In the early days both of the individual and of the study such caution is both desirable and necessary; there is an undoubted temptation to relax the criterion which must be applied before truth can be firmly established. But when the individual and the study have come to full maturity the danger has passed away; there is now no need to insist at every turn that science must have a firm experimental basis. The time has come to face the facts boldly. The search for truth alone never has and never will lead to any science of value. The spirit which must be so carefully curbed in the search for truth must be given free rein when truth is attained. Our passionate desire that truth will be found in one form rather than in another must never be allowed to influence our decision in what form it actually appears; but once that matter is settled, we not only may but must choose in accordance with our desire in which of the innumerable alternative forms that truth must be expressed; the more freely we choose, the more likely it is that a renewed search for truth will confirm our choice.

The attempt to conceal from ourselves that choice is necessary may stifle the imagination on which the choice depends; and therefore I make no apology for insisting, even at the risk of irrelevance, on the necessity of proclaiming openly the imaginative element in science. Our view of the meaning of science must influence our methods of teaching and training ourselves and our pupils; 19th-century philosophy, with its anxiety to conceal the essential part played by imagination in scientific discovery, is largely responsible for the ineptitude of modern scientific education. The very man who laughs to scorn the doctrine that a love of literature or an imaginative appreciation of its value is to be obtained by the grinding out of Latin hexameters will proceed gravely to assert that science is to be taught only by the determination of the nodal points of lens systems. Of course for the student who means to take science seriously and hopes in his turn to take his share in its advancement, a thorough training in the experimental art is as essential as is a complete understanding of the intricacies of meter and construction to the classical scholar. But neither the scholar nor the man of science will have a living grasp of his study if he buries himself in these pedantries. The scientific imagination can be developed by tedious laboratory practice no more than the artistic imagination by the laborious study of Greek particles, by the day-long practice of a musical instrument, or by unceasing copying in the galleries. It must come from direct and intimate contact over the widest possible range with the great original works which represent its noblest expression. It is doubtless difficult to introduce a student to the latest modern theories of solid structure, of atomic constitution, or of relative motion, before he has an entire understanding of what are commonly regarded as the elements of physics; but it is no more difficult than to teach a boy to read the *Odyssey* before he can parse and interpret any word; and the failure to overcome the difficulty is equally disastrous.

Doubtless "there is nothing like leather," but I cannot refrain from suggesting that it would have been better if chemistry had not come to be regarded as the standard and natural "elementary" science. For chemistry, so rich in laws (though not often explicitly named as such) and so powerful in the ordering of facts, is poor in theory. And since it is in theory that the highest meaning of science is expressed, chemists are more apt than the students of other sciences to overlook its vital importance. The absurdities of the "heuristic" school, fortunately short-lived, could hardly have taken root at all in any other soil; no physicist could imagine that there was any similarity between the "discovery" of a law by the elementary pupil under the eye of his teacher and the true discovery of that law when it was unknown. Chemistry has but one noteworthy theory and but one set of hypothetical ideas, the theory of the combination of atoms into molecules with is fundamental idea of valency. It is a most beautiful theory, surpassed by none other in the intellectual satisfaction it affords, but unfortunately it is not easily or certainly applicable to the compounds on which the attention of the elementary student is concentrated; we know far less about the constitution of water than about that of some organic compound with a name a yard long—long simply because the theory is so strictly applicable to it. If chemistry is to be the vehicle of elementary instruction in science, we should begin with stereoisomers and proceed (if we have time) to the simple compounds of oxygen, hydrogen, and nitrogen.

Nor should we think only of the effect of our repression on those who are serious students of science. The opinion of our fellows, even if they are not our colleagues, cannot fail to react, directly or indirectly, on our own studies. If scienific education today is unsuited for those who are to make science their life work, it is even less suited for those to whom it is merely to be part of a general education. Men of science complain of the lack of a wide appreciation of scientific knowledge; what else can they expect if they offer to the world only the dry bones of knowledge from which the breath has departed? Nothing could be better adapted than the ordinary school course, with its tedious insistence on bare and uninspiring facts, to kill any rising enthusiasm. It is important certainly to impress the student with the nature of scientific truth and with the possibility of definite positive knowledge concerning the material world. No doubt it is the failure to realize that there is such knowledge, the mistaken notion that everything is a matter of opinion on which two sides should be heard, that produces, so ludicrous if it were not so lamentable, the familiar chaos in the administration of the affairs of state and industry by the half-educated persons who pride themselves on their ignorance of science. But to insist on the truth of science and to neglect its meaning is to aggravate the evil which we seek to cure; those who are endowed with any measure of creative imagination can never hold in anything but contempt a study

from which such imagination appears to be wholly banished.

Such attempts as are made to exhibit the imaginative element in science are almost more disastrous than the attempts to conceal it. The "romance of science" is usually associated with childish books and popular lectures on speculative geology and "spherical" astronomy (*2*). Now both geology and astronomy are magnificent sciences, offering superb examples of the highest meaning of science; but they also contain elements, of no importance to their earnest students, which possess a specious and flashy interest which makes a passing appeal to shallow minds. An audience of children of all ages gapes amazedly while the lecturer discourses glibly of times reckoned in millions of years and distances in thousands of millions of miles. But science has something better to offer than sensational journalism; nothing could be less characteristic of its spirit. The mere fact that the interest of the uninitiated can thus be easily stimulated with[out] serious training suggests doubts of the value of the stimulus; nothing worth having in this world is to be had without effort.

Science and Art

When we so often hide what is best in science and display only its less admirable features, it is not surprising that in the outside world there is suspicion of its ultimate intellectual value. There has been in recent years a great improvement in the general appreciation of the meaning of science; but open antagonism has been in part replaced by an armed neutrality which indicates no better understanding, but merely greater caution. Many will still be found to deny that science can satisfy our imaginative needs to the same extent as art and literature, and the denial does not arise only from conservatism and ignorance. Science, it is said, is impersonal; the highest good must be intimately connected with personality. It is overlooked that the impersonal truth of science is inseparable from its personal meaning. Science, it is said, is mechanical; the accusation at once displays the misunderstanding. A mechanism is certainly something which will produce desired results independent of the attention or volition of a skilled operator, but it is also something which is and must be the individual product of a human mind. A mechanism implies an inventor; it is a means by which one exceptionally endowed man makes his endowments available for the common good; it is something characteristic, not of dead matter, but of the highest spirit of man; it is something that theologians and savages do not understand. If the term is rightly understood science is truly mechanical; for science, like mechanism, is the expression of genius in a form which the dullest can appreciate.

It is curious how even today the laity seem unaware of the part played by the genius of great men in the development of science. They recognize perhaps that the often quoted examples of the greatest achievements of science, the discovery of Neptune or of Hertzian waves, represent something not easily attained by the common mass of mankind; they are willing to admit that Newton or Leverrier, Maxwell or Hertz, must have had some qualities to distinguish them from lesser folk. But they have no knowledge of what these qualities are; they have no idea that their work was an expression of their personality just as surely as the work of Giotto, of Shakespeare, or of Bach. They still tend to contrast the cold-blooded rationalism of the man of science with the passionate dreamings of the artist. But science too has its dreamers, and their dreams come true; they dream, and messages flash across the empty ocean; they dream again, and a new world springs into being and starts upon the course that they have ordained. Nor does the quest of knowledge inspire less passion than the quest of beauty. It is not sickly sentimentality but honest emotion that makes us cry (*3*):

> "Car c'est chose divine
> D'aimer, lorsqu'on devine,
> Rêve, invente, imagine
> À peine. . . ,
> Le seul rêve intéresse;
> Vivre sans rêve, qu'est-ce?
> Et moi, j'aime la princesse
> Lointaine."

Nothing could be more absurd than the attempt to distinguish between science and art. Science is the noblest of the arts and men of science the most artistic of all artists. For science, like art, seeks to attain esthetic satisfaction through the perceptions of the senses; and science, like art, is limited by the impositions of the material world on which it works. The lesser art accepts those limitations; it is content to imitate or to describe Nature and to follow where she leads. The greater refuses to be bound; it imposes itself upon Nature and forces her to submit to its power. The apostle of Art in a previous generation can make no higher claim for the greatest art than this (*4*):

"CYRIL. But you don't mean to say that you seriously believe that Life imitates art, that Life in fact is the mirror, and Art the reality?

"VIVIAN. Certainly I do. Paradox though it may seem—and paradoxes are always dangerous things—it is nonetheless true that Life imitates art, far more than Art imitates life. We have all seen in our own day in England how a certain curious and fascinating type of beauty, invented and emphasised by two imaginative painters, has so influenced Life, that, whenever one goes to a private view or to an artistic salon one sees, here the mystic eyes of Rossetti's dream . . . there the sweet maidenhood of the 'Golden Stair' the blossom-like mouth and weary loveliness of the 'Laus Amoris'. . . . And it has always been so. A great artist invents a type, and Life tries to copy it, to reproduce it in a popular form, like an enterprising publisher. . . . Literature always anticipates life. It does not copy it, but moulds it to its purpose. The nineteenth century, as we know it, is largely an invention of Balzac."

But if to lead the way and to bid life follow is the distinctive character of the greatest art, what art can be so great as science? A Newton, a Faraday, or a Maxwell conceives a theory and Life adapts itself for all time to the laws which it predicts; by the force of his imagination he creates no passing fashion, but the permanent structure of the world. He is no puny creature closely bound by the laws of time and sense; he is the creator who lays down those laws; verily the winds and the waves obey him.

Of course such powers are not given to all who pursue science. There are degrees of scientific as of artistic imagination. But the least of us can share in some small measure these achievements. A man need not abandon all pretensions to the proud title of artist because he could not design the Parthenon or write the *Fifth Symphony*. Most of us who have attempted to advance science have had our all too brief and passing moments of inspiration; we have added a single brick to the mighty structure or finished some corner which the master in his impetuosity has overlooked. And though our tiny efforts rightly pass almost unnoticed by the rest of mankind, they have a value for ourselves beyond what we can tell; one instant we have stood with the great ones of the earth and shared their glory. Even if nothing as yet has stirred in us the creator's joy, we can yet appreciate the success of others. Nobody who has any portion of the scientific spirit can fail to remember times when he has thrilled to a new discovery as if it were his own. He has greeted a new theory with the passionate exclamation: It must be true! He has felt that its eternal value is beyond all reasoning, that it is to be defended, if need be, not by the cold-blooded methods of the laboratory or the soulless processes of formal logic, but, like the honor of a friend, by simple affirmation and eloquent appeal. The mood will and should pass; the impersonal inquiry must be made before the new ideas can be ad-

mitted to our complete confidence. But in that one moment we have known the real meaning of science, we have experienced its highest value; unless such knowledge and such experience were possible, science would be without meaning and therefore without truth.

References and Notes

1. Perhaps this statement is not quite true. The system of thought against which Huxley was especially concerned to defend science was theology, and some theological systems rest, not on common sense, but on immediate and fundamental judgments or revelations which are definitely stated to be confined to the elect. Such systems have not the truth characteristic of science. The value of their propositions is determined wholly by principles analogous to the second and not at all by those analogous to the first.
2. I have heard this term used wickedly to denote the form of science which, at the end of the 19th century, was closely associated with the name of Sir Robert *Ball*.
3. E. Rostand, *La Princesse Lointaine*.
4. O. Wilde, *The Decay of Lying*.

Natural and Cultural Aspects of Floods

Paul B. Sears

Nature makes floods, but man makes flood hazards. Although there is no known way to prevent floods, much can be done to minimize flood damage. Protection, not prevention, therefore, is the real problem. Effective protection can come about only from improved land use and management, based on a better understanding, by the general public, of the relation between water, land, and ground cover.

Ordinarily water which has been evaporated from the ocean and moved inland by air falls on land and returns to the sea through stream channels cut by the flow of water. When the amount is too great for the channel to carry, the water rises and spreads out over the land. This we call a flood.

Stream channels swing back and forth as time goes on, producing level plains on each side. These are called floodplains, for the very good reason that they are flooded when the channel cannot handle all the water that is present.

Modern Flood Settings

Like many others of my vintage, I have been observing floods off and on for more than a half-century and have read about many that I have not seen. As far as I can recall, these floods, whether in Arkansas, California, Florida, Mexico, New England, Ohio, Oklahoma, or Utah, had one feature in common. They took place where earth-forms and vegetation gave clear warning that man should be on guard.

Not all floods take place, however, in what can technically be considered flood plains within stream valleys. Thus at Bellevue, Ohio, the citizens long considered themselves unusually fortunate in that they could dispose of their sewage by simply poking a hole in the underlying limestone. Waste, poured into this hole, vanished. That is, it vanished until March 1913—a month of rapidly melting snow and excessive rainfall. Then the good people of Bellevue suddenly found themselves immersed and mysteriously so. They had been taking advantage of an underground river which flowed beneath them through tunnels cut in the limerock. This stream, suddenly overloaded, relieved the pressure by surging upward through the vents they had made in order to get rid of municipal waste.

Another type of destructive flood that does not involve a valley, properly speaking, occurred near Arcadia, Florida, during the rainy season of 1918. Here the Army had established a flying center, known as Dorr Field, in a rather extensive, treeless area. This seemed logical enough at the time. Much of the space was grassy prairie, the rest low-growing scrub palmetto, which could be scraped away by gangs of workmen. There were no troublesome pine trees to be reckoned with, and the whole area was quite flat.

All went well until the rains came. Then, suddenly, the whole post was transformed into a shallow lake, and much valuable property was submerged.

Had the engineers bothered to consult any local naturalist, all of the trouble might have been avoided, for prairie growth is the characteristic vegetation in areas that are regularly flooded during rainy season. Surrounding these prairies, and separating them from the pine flatwoods on slightly higher ground that is never flooded, is a zone of scrub palmetto, covered occasionally by high water. Thus, Dorr Field was bound to be submerged at times.

Today, nearly 40 years later, the growing economy of Florida is pressing upon these same treeless stretches that form the low backbone of the peninsula, not many feet above sea level. This pressure extends to the lower lying marshes and swamps known as Everglades, naturally filled with water the year round. The demand for more pasture and horticultural space is being met by vigorous efforts to drain away both seasonal and permanent water into the surrounding seas. This means, at times, an abnormal load of water moving through almost level land and across the densely populated and highly developed seaside margin of the state. The problem thus created is obvious, and the cultural element in it, equally so.

Lower mountain slopes in California, Utah, and Colorado provide a somewhat different example. Mountains wear away through the ages, of course, and lowlands are built up by virtue of this process. But the process becomes catastrophic when the mountainside vegetation that normally restrains the violence of moving water is destroyed by fire, excessive grazing, or the plow. When this occurs, not only does water pour down in abnormal volume, but rocks of incredible size are converted into rolling missiles, that wipe out homes and schools, orchards and roads.

An excellent example of this phenomenon can be observed in the Wasatch Mountains north of Salt Lake City. Here are two steep watersheds, side by side. One has been protected from the time of settlement, since it provides a municipal water supply. Its vegetation is intact, and neither rain nor melting snow has caused flood or brought down sediment in excess of the geologic norm. Next to it is Parrish Canyon, whose sides have been cleared and heavily pastured. Here, in 1928 and subsequently, surprisingly small amounts of rainfall on the upper slopes have gathered headway, bringing down

Dr. Sears is chairman of the Yale University Conservation Program. This article is based on an address presented, 29 Dec. 1956, at the AAAS meeting in New York.

masses of earth and rock to debouch on the valley margin below, with results disastrous to roads, homes, public buildings, and fertile acres.

The mood of national remorse during the 1930's made it possible for the Government to acquire this watershed and take stabilizing measures, using CCC workers to terrace and replant the steep slopes. This has worked so well that, as one technical man said: "The people below have now rebuilt. They have more confidence in what we have done than we do ourselves. We can't promise no more floods, even with the slopes protected by plant life."

Old-Time Floods

Turning now to floods of the more conventional river-valley type, antiquity furnishes us with at least two vividly contrasting patterns—those of the Nile and the Tigris-Euphrates. The Nile, flowing through a broad and gentle valley far downstream from its sources, rises and falls in orderly fashion as an aggrading stream, leaving a coating of nutrient material that enhances the agricultural value of the valley without producing devastation.

The twin rivers, on the other hand, flow less than half the distance covered by the Nile and arise in mountainous terrain rather than in swampland. As a result, floods are likely to be violent and to come without warning. The only safeguard is to be on the alert during the season of melting snows and heavy rainfall—a circumstance which is believed to have had something to do with the early development of astronomy and the calendar in Mesopotamia, Moreover, the terror of flood is a familiar feature of near-Eastern tradition and folklore.

Such an area is vulnerable to deforestation in the upper reaches of the valleys. This would not only augment the violence of moving water but would greatly increase the load of silt brought down by it. The accumulation of this silt through the millenia imposed a burden on the otherwise efficient irrigation system of the Tigris and Euphrates. This greatly lowered its efficiency, even before its destruction by invaders in the 13th century.

In former times, in the lower Mississippi flatlands, it was possible to take advantage of conditions not unlike those in the Nile Valley. Levees were built at right angles to the stream, to moderate its force while allowing it to spread out, rather than attempting to confine it to channel. Livestock and people were moved to high ground, returning after the spring flood to find the fields enriched. But, today, the pressure of population for space makes such a leisurely give-and-take impossible, as it has long been on the crowded, level plains of eastern China and India.

Industrialization and Floods

The flood problem in New England, a highly urbanized industrial area, shows an interesting combination of geologic, climatic, and human elements. In order to reach Long Island Sound, Connecticut rivers have cut channels through whatever material is in their way. Where this material is soft, the swinging channels have cut wide flood-plains. But in many places the streams have cut down through hard volcanic rock. At such places we have narrow gorges with little or no flood-plain. These gorges choke the flow of high water, backing it up still higher on the broad flood-plains upstream.

When New England was settled, mills were built close to the stream channels, because of the need for water power. Homes, however, were built on high ground, safe above flood level. With the shift to steam and electricity, water was needed for processing and for waste disposal, so factories expanded in the old locations along the channel. Because the flood-plains were relatively level, roads and railroads were built along them. And as population increased, residence and business construction came down into the flood-plain, too.

These developments all served to increase flood hazard by occupying space which, throughout geologic history, had been subject to frequent occupation by high waters. The hazard has been further increased by structures which block the channel itself, by bridges of types which constrict the channel, and by lumber- and junk-yards full of loose material that can be washed down against bridges, converting them into dams.

It is often said that deforestation causes floods. This is a half-truth. Water flows faster, and in greater amounts, off of cleared land than off of forested land —up to a certain point. When rainfall exceeds the critical amount, especially on shallow soils such as we have in New England, not even forests will hold it back. Actually, with some two-thirds of its acreage in forest, New England is in pretty good shape as far as natural cover is concerned. On the other hand, an increasing amount of land along the valleys has no vegetation at all, since it is covered with waterproofed buildings, roads, parking lots, and sidewalks. It is safe to say that the water which falls on such places contributes directly to floods.

Flood Protection

A means of flood protection often mentioned is the storage of water in reservoirs. To be any good for this purpose, reservoirs must either be empty, like those above Dayton, Ohio, or have plenty of empty reserve space, like those in the Muskingum Conservancy district. These conditions are hard to meet in New England, where choice reservoir sites are already being used mainly to store up water for use. Additional reservoir sites are in the wide flood-plains now occupied by urban and industrial developments, which could be moved only at great cost.

To make matters worse, we are rapidly destroying an excellent source of natural storage by filling in swamps and marshes above the river mouths. Until now the only objections to this filling have come from nature lovers, who prize the plants and animals that make swamps and marshes so interesting. It is time for us to begin to weigh carefully the damage that may result in times of heavy rainfall if there are no spongy basins to hold part of the excess water.

Finally, since floods come from falling water, it is essential to remember that rainfall figures represent averages. The amount and intensity of precipitation at any given place are unpredictable, varying within wide limits. Fifteen inches or more of rain in 3 days would be expected, statistically, only once in 1000 years or more, yet we had such rains twice in one season last year.

All this adds up to the fact that water makes flood-plains and has the first right to them. Any competition with water for this space must be regarded as a calculated risk, to be taken with eyes open. Storage of surplus water and proper ground cover help reduce the risk but cannot eliminate it. In short, all available evidence justifies the view of Leopold and Maddock in their excellent book, *The Flood Control Controversy*. High waters cannot be prevented, but they can be intelligently dealt with. Water problems are complex, both from the natural and the cultural standpoint. Each situation must be studied on its merits; there are no blanket solutions guaranteed to work everywhere. The surest safeguard lies in better understanding, on the part of each citizen, of the facts of his environment—physical, biological, and social. The ecologist, as teacher, citizen, and investigator, must contribute to this understanding. Perhaps in this way we can come to realize that ecological hazards do exist and, thus, come to accord them the same respect that we now give to hazards in law, engineering, and economic matters.

News of Science

IGY Communications System

A world-wide communications network for the International Geophysical Year, with its focal point at the National Bureau of Standards radio forecasting center at Fort Belvoir, Va., has been established and is ready to go into operation at the start of the IGY in July. Extending virtually from pole to pole, and combining the commercial and governmental communications facilities of 40 nations, this constitutes by far the largest such system ever set up.

During the 18-month IGY period, observations of conditions on the sun and soundings of the ionosphere all over the world will be coordinated daily at five primary regional stations—in the Netherlands near Amsterdam, and in Moscow, Tokyo, Sidney, and Anchorage. From these points reports will be sent to Fort Belvoir, where they will be combined and evaluated and a final decision made on whether or not a world alert is justified. If so, warnings will be sent to the IGY stations of the 40 cooperating nations to redouble observational efforts in anticipation of unusual activity of cosmic rays, northern lights, earth magnetism, and radio propagation disturbances.

The system has been organized so that IGY scientists, no matter where they are, can conduct their experiments simultaneously. Messages will be sent from Fort Belvoir at 11 A.M. each day (16 hours Greenwich time). Within 8 hours, the three tests held to date indicate, these will arrive at the remotest IGY outposts, with the possible exception of Antarctica, which can be difficult to reach under certain unusual circumstances. Australia can be alerted from Belvoir in a maximum of 2 hours, Moscow in 40 minutes.

Over-all solar activity is measured and predicted in terms of the 11-year sunspot cycle and the 27-day period of the sun's rotation as observed from the earth. Many solar phenomena, such as enormous flares, prominences, and activities of various solar regions, vary according to the same time cycles. However, there are occasional short-term spurts, lasting a few days or hours and usually quite localized on the sun's surface, which do not appear to be cyclic and which are associated with geophysical phenomena on earth.

The IGY warning agency will issue two types of warnings—alerts and special world intervals—when major solar-terrestrial disturbances are expected. It is not economically feasible for scientists to make intensive world-wide observations every day during the 18 months of the IGY program. Just the cost of film would be prohibitive for smaller observatories. Similarly, the warning system is essential to the rocket-launching program, for which a limited number of rockets is available.

After due consideration of conditions that are predictable far in advance, a series of regular World Days has been selected for detailed simultaneous observations all over the world. Because of the unpredictability of some factors, however, it has been necessary to supplement the World Day program with special "world intervals," periods of a few days of particularly favorable observing conditions.

The alerts sent out from Belvoir will notify observers that a special world interval may be called in a few days. There will be about 8 hours notice for such a period, which will only be scheduled when there is a strong possibility that a major solar-terrestrial disturbance will begin within about 24 hours after the start of the interval. The special observing period will end when the disturbance subsides, or in about 24 hours if it should not materialize. As the program is now organized, the sun will be under close observation throughout the 24 hours somewhere in the world, and there will be ionosphere soundings once every 3 minutes instead of about four times an hour as is the practice today.

In arriving at a decision on calling an alert, about 13 factors, as reported from all over the world, will be taken into consideration. Among the most significant of these, in addition to ionosphere soundings, will be the following: solar plages; surges, streams of material ejected high into the solar corona, and even into space, at speeds of the order of 500 kilometers a second; prominances, cloudlike bodies of glowing gas that appear above the sun's chromosphere; emission corona, very faint emissions from the solar corona in wave lengths of highly ionized iron, nickel, and other metallic elements; radio noise regions, radio emissions from the sun that differ notably for various regions on the solar surface; and geomagnetic disturbances.

For observation of these phenomena the Bureau of Standards maintains two stations, the one at Belvoir and one at Anchorage, Alaska. The world warning agency is headed by Roger C. Moore of the NBS staff.

Revised Chromosome Count?

Further information about the chromosome numbers in man [*Science* **125**, 542 (22 Mar. 1957)] has been made available by M. Kodani [*Proc. Natl. Acad. Sci.* **43**, 285 (Mar. 1957)]. In 16 out of 20 testes of Japanese adults, the chromosome number was 48 in the spermatogonia and 24 (bivalents) in the first spermatocytes; in the remaining four testes, the chromosome number in the spermatogonia was 46 and 23 (bivalents) in the first spermatocytes.

In interpreting his results, Kodani says: "A comparison of the chromosomes of first metaphases of the 46- and 48-chromosome types suggests that a pair of simple supernumerary chromosomes of very small size is present in the latter type and absent in the former. This presumed supernumerary was expected to occur singly in some Japanese. They should have 47 chromosomes in the spermatogonia and one univalent in addition to 23 bivalents in the first spermatocyte metaphases."

In confirmation, Kodani has obtained a testis with 47 spermatogonial chromosomes and is continuing the study of its first-metaphase chromosomes. According to Koldani, all three diploid numbers (46, 47, 48) probably exist in other human groups, such as whites and Negroes, "although the proportion of the three types may be different from group to group."

Europe's Most Powerful Telescope

A telescope for the Haute-Provence Observatory at Saint-Michel (Basses-Alpes) arrived in Marseille, France, on 21 Mar. When installed, it will be Europe's most powerful telescope and second only to the one at Mount Palomar, Calif. It will have an aperture of 6 feet and will be lodged in a special dome more than 65 feet in diameter and slightly less than 80 feet high. The telescope was built by the London firm of Grubb and Pasons.

The instrument's mirror is now being completed by a specialist of the Paris Observatory. According to the press, the mirror was originally cast at the beginning of World II and secretly taken to Saint-Michel to keep it out of the hands of the Germans. It was returned to Paris in 1952 to be completed. It weighs 1½ tons.

The special dome, the sixth at the Haute-Provence Observatory, will be equipped with eight suction devices that are expected to make possible better photographs by eliminating unnecessary air movements within the dome. Other equipment includes a 16½-foot spectroscope and an electronic camera.

The installation of the telescope will take only a few weeks; however, the mirror will not be ready before October. Since the final adjustments will also take a few more months, the telescope is not expected to be in full operation until the beginning of 1958. It will be used under the direction of Charles Fehrenbach, science professor at the University of Marseille, and director of both the Marseille and Haute-Provence Observatories.

Missouri Medical Center

The University of Missouri has dedicated its $13,600,000 Medical Center. In addition to the 441-bed teaching hospital, the center includes a Medical Science Building and a nurses home. The new facility makes possible a 4-year medical course for the first time since 1910.

Antibodies

U.S. Public Health Service scientists have reported the first direct measurement of the rate at which the tissues of a human being manufacture antibodies against disease. They made their observations by transplanting from one person to another the lymph node system involved in producing antibodies.

The research patient, a 64-year old woman, was selected for the study because she had the rare disease hypogammaglobulinemia. This disease offers an ideal opportunity for studying the mechanisms of immunity, because (i) the lack of antibodies characteristic of this condition enables measurements of production, once a system for manufacturing them has been "installed"; (ii) patients with hypogammaglobulinemia will tolerate transplants that would deteriorate in a few days in normal people; (iii) transplantation of the lymph node system is theoretically beneficial to the patient.

The studies were conducted by C. M. Martin and N. B. McCullough of the National Institute of Allergy and Infectious Diseases, in cooperation with J. B. Waite of the National Cancer Institute. Their results appear in the current issue of the *Journal of Clinical Investigation*.

In June 1955 the transplantation was undertaken. The surgeons made eight incisions in each thigh. In a concurrent operation on the patient's sister, they obtained 16 lymph nodes and planted a slice of node in each incision. The other eight slices were preserved for comparison studies.

On the 7th, 14th, and 20th days after transplantation, the patient was challenged with injections of typhoid vaccine. She responded by making typhoid H and O antibodies. The transplanted nodes were performing the function her own system had lacked—that of producing antibodies against disease. She had further responses to booster doses of vaccine on the 68th and 98th days. Presumably the death of the nodes occurred between the 150th and 160th days. A sensitivity to tuberculin antigen acquired from the donor remained months after the transplants apparently ceased functioning.

Applying statistical methods to observed levels of antibodies and dividing by the weight of the transplanted tissue (845 milligrams) the research team obtained a series of values for each day that represent the first direct measurement in a human being of the rate at which tissue manufactures a protein (in this case antibodies) in the blood.

The findings suggest that human lymphoid tissue normally responds with remarkable speed, versatility, and production capacity to a challenge from an invading organism and can "tailor make" antibodies of different patterns to meet different challenges just as quickly as other tissues are turning out unvarying products such as enzymes and hormones.

Kimble Award Nominations

Nominations for the sixth Kimble methodology research award may be sent to the Conference of State and Provincial Public Health Laboratory Directors *until 1 June*. This award, established by the Kimble Glass Company, consists of $1000 and a silver plaque. It will be presented at the annual meeting of the conference to be held in Cleveland, Ohio, in November.

Candidates' work to be considered for nomination should be either (i) a fundamental contribution that serves as a baseline for development of diagnostic methods that fall within the province of the public health laboratory, or (ii) the adaptation of a fundamental contribution to make it of use in a diagnostic laboratory. Candidates must be from the United States, its territories, or Canada.

Nominations may be made by authors, their associates, or others. A nomination should be accompanied by a statement justifying the recommendation, six summaries of the work, and six reprints. If reprints are not available, six summaries with bibliography will be accepted.

Nominations may consist of a group of workers or one author. If the former, the cash award will be divided among the workers but the plaque accompanying the cash award will become the property of the laboratory where the work is done. Nominations should be sent to the chairman of the nominating committee, Howard L. Bodily, State Department of Public Health, Division of Laboratories, 2151 Berkeley Way, Berkeley 4, Calif.

Improving Advanced Undergraduate Courses in the Biological Sciences

An idea for redesigning college courses and textbooks in the biosciences to meet the criticism that courses are not keeping pace with fundamental advances in their fields is being tested by the Committee on Educational Policies of the Biology Council, Division of Biology and Agriculture, National Academy of Sciences–National Research Council. The plan is to ask an *ad hoc* panel of competent people in a given field to redefine course objectives and develop a comprehensive outline, to be published for the guidance of instructors and authors. The panel would produce only the single report, for the aim is not to replace one orthodoxy by another but to initiate what could become a continuing process of cooperative reevaluation of courses.

Aided by a National Science Foundation grant, the committee is testing the plan in two areas. If trial indicates the approach is sound, the committee hopes that professional societies and others concerned with particular subjects will be encouraged to sponsor similar critical studies of college courses.

The test fields are parasitism and systematic botany. Members for both panels were selected on the basis of suggestions from a number of sources, including the American Society of Parasitologists and the American Society of Plant Taxonomists. Reports, which are due by July, will be published in journals or by the Academy–Research Council. Both panels will appreciate suggestions and ideas on the form and content of undergraduate courses in their subjects.

Members of the *ad hoc* panel on systematic botany courses are Lincoln Constance (University of California, Berkeley), *chairman*, Harlan Lewis (University of California, Los Angeles), Reed

Rollins (Harvard University), Robert Thorne (State University of Iowa), W. Herbert Wagner, Jr. (University of Michigan). The parasitism panel includes: Clay G. Huff (Naval Medical Research Institute), *chairman,* L. O. Nolf (State University of Iowa), Richard J. Porter (University of Michigan), Clark P. Read (Johns Hopkins University), A. Glenn Richards, Minnesota), A. J. Riker (University of Wisconsin), and Leslie A. Stauber (Rutgers University).

Harvard Postdoctoral Dental Program

Harvard University, starting in September 1957, will launch a new program in dental medicine intended to prepare young dental graduates for careers in academic dentistry. The 5-year postdoctoral study program, made possible through a grant of $162,000 from the Public Health Service, will be carried on within the Harvard School of Dental Medicine.

The new program will be under the immediate direction of Reidar F. Sognnaes, associate dean of the school, and will be carried on in collaboration with the basic science department of the Harvard Medical School and the affiliated clinics at the Forsyth Dental Infirmary for Children, Children's Hospital, and the Massachusetts General Hospital. Three postdoctoral students will be admitted to the program in the first year, with three additional students added each year for the first 3 years. For the present, the program will be limited to a total of nine students.

Coffinite in New Zealand

Coffinite, a highly radioactive uranium mineral, has been found in rocks of the Buller Gorge region of the South Island of New Zealand, J. J. Reed and G. G. Claridge of New Zealand have reported. The mineral, first discovered in 1955 on the Colorado Plateau in the United States, has also been made in the laboratory. Coffinite is a uranous silicate with the chemical formula $USiO_4$; it contains as much as 61 percent uranium. Highest amounts of uranium in minerals are found in the uraninites, which have about 85 percent.

University of Wisconsin–Milwaukee

The University of Wisconsin–Milwaukee was created by merger of the former Milwaukee Center of the University of Wisconsin and the Wisconsin State College, Milwaukee. Now in its first year of operation, it is a 4-year, degree-granting autonomous unit of the University of Wisconsin that is under the control of the University Board of Regents.

This new section of the university is composed of a College of Letters and Science, a School of Education, a Division of Commerce, a Division of Engineering, and a Division of Pharmacy. A 1-year program in home economics completes the programs currently available. Graduate work leading to a masters degree is available in education, social work, engineering, commerce, and some areas in letters and science.

Joseph G. Baier, professor of zoology, has been named dean of the College of Letters and Science. Eldon D. Warner, associate professor of zoology, is chairman of the zoology department, and other appointments are as follows: Ray U. Brumblay, associate professor and chairman of the chemistry department; Ruth I. Walker, professor and chairman of the botany department; T. Alton Rouse, professor and chairman of the physics department; and Harvey Uber, professor and chairman of the geography department.

Zoological Nomenclature

The International Commission on Zoological Nomenclature has announced that beginning 29 Sept. it will start voting on the following cases involving the possible use of its plenary powers for the purposes specified. Full details were published in the 29 Mar. issue of the *Bulletin of Zoological Nomenclature* (vol. 13, Double-Part 2/3 and Part 4): (i) VIVIPARIDAE Gray (J.E.), 1847, validation and counter-proposal for suppression of *Viviparus* Montfort, 1810 (Cl. Gastropoda); (ii) *mississipiensis* (emend. of *mississipiensis*), validation of, as specific name for North American Alligator (Cl. Reptilia); (iii) MUNTIACINAE Pocock, 1923, and ODOBENIDAE Allen (J.A.), 1880, validation of for the Barking Deer and Walrus, respectively (Cl. Mammalia); (iv) *Dictyoploca* Jordan, 1911, validation (Cl. Insecta, Order Lepidoptera); (v) *Staphylinus* Linnaeus, 1758, designation of *Staphylinus erythropterus* (emend. of *erytropterus*) Linnaeus, 1758, as type species of (Cl. Insecta, Order Coleoptera); (vi) *Anopheles* Meigen, 1818, designation of type species for (Cl. Insecta, Order Diptera); (vii) *picta* Walckenaer, 1802 (*Aranea*) and *Theridium* (emend. of *Theridion*) Walckenaer, 1805, validation (Cl. Arachnida); (viii) *Vespertilio murinus* Linnaeus, 1758, type species of *Vespertilio* Linnaeus, 1758, clarification of interpretation of (Cl. Mammalia); (ix) *Toxorhynchites* Theobald, July 1901, validation (Cl. Insecta, Order Diptera); (x) *truncatula* Bruguière [1792] (*Bulla*), interpretation of and *umbilicata* Montagu, 1803 (*Bulla*) validation (Cl. Gastropoda). Comments should be sent as soon as possible and in duplicate to the Secretary of the Commission, Francis Hemming, 28 Park Village East, Regent's Park, London, N.W.1.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills introduced recently follows:

S 889. Authorize a 4-year program of federal assistance to states and communities to enable them to increase public elementary- and secondary-school construction. Smith (R N.J.), *et al.* Senate Labor and Public Welfare.

S 1021. Amend National Science Foundation Act to authorize award of certain scholarships. Pastore (D R.I.) Senate Labor and Public Welfare.

H J Res 200. Establish an international university. Burdick (R N.D.) House Foreign Affairs.

HR 4014. Protect public health by amending the Federal Food, Drug, and Cosmetic Act to provide for safety of chemical additives in food. Delaney (D N.Y.) House Interstate and Foreign Commerce.

HR 4015. Protect the public health by amending Federal Food, Drug, and Cosmetic Act to provide for safety of chemicals in cosmetics. Delaney (D N.Y.) House Interstate and Foreign Commerce.

HR 4134. Encourage prevention of air and water pollution by allowing cost of treatment works for abatement of air and stream pollution to be amortized at an accelerated rate for income-tax purposes. Simpson (R. Pa.) House Ways and Means.

HR 4139. Authorize and request President to undertake to mobilize in U.S. an adequate number of outstanding experts, coordinate and utilize their services in an endeavor to discover means of curing and preventing cancer. Staggers (D W.Va.) House Interstate and Foreign Commerce.

HR 4211. Provide for further research and technical assistance required for control of mosquitoes and other arthropods capable of adversely affecting health and welfare of man. Magnuson (D Wash.) House Interstate and Foreign Commerce.

HR 4217. Amend further the Federal Civil Defense Act of 1950, as amended, to authorize Federal Civil Defense Administration to procure radiological instruments and detection devices. Ostertag (R N.Y.) House Armed Services.

S J Res 48. Provide for training of

teachers in certain studies. Magnuson (D Wash.) Senate Labor and Public Welfare.

HR 4525. Amend Internal Revenue Code of 1954 *re* contributions and gifts by corporations to or for use of schools of engineering and related technical subjects. Reuss (D Wis.) House Ways and Means.

S 1087. Authorize construction of a shellfish research laboratory and experiment station in Chesapeake Bay area. Butler (R Md.) Byrd (D Va.) Senate Interstate and Foreign Commerce.

S 1109. Provide for preservation of historical and archeological data (including relics and specimens) which might otherwise be lost as result of construction of a dam. Magnuson (D Wash.) Senate Interior and Insular Affairs.

HR 4263. Provide for construction of a fish and wildlife marine laboratory and experiment station in central gulf coast area of Florida. Cramer (R Fla.) House Merchant Marine and Fisheries.

Psychiatry Professorships

The Foundations' Fund for Research in Psychiatry has announced the availability of funds for the establishment of two or possibly three research professorships for research psychiatrists in medical-school departments of psychiatry. The closing date for applications will be *31 Oct. 1958*. For further information, interested departments or individuals are invited to write to the Foundations' Fund for Research in Psychiatry, 251 Edwards St., New Haven 11, Conn.

New Journals

Automation Progress, the Journal of Automatic Production and Control, vol. 2, No. 1, Jan. 1957. Leonard Hill Limited, Stratford House, 9 Eden St., London, N.W.1.

Biological Series, Publications of the Museum, Michigan State University, vol. 1, No. 1, 15 Mar. 1957. *The Least Tern in the Mississippi Valley* by John W. Hardy. Rollin H. Baker, chairman, Editorial Committee. The Museum, Michigan State University, East Lansing, Mich. Irregular, available on exchange basis.

Journal of Insect Physiology, vol. 1, No. 1, Mar. 1957. V. G. Dethier, H. E. Hinton, and M. Luscher, Eds. Pergamon Press, 122 E. 55 St., New York. Quarterly, 4 issues per vol. $9.80 per vol.

IBM Journal of Research and Development, vol. 1, No. 1, Jan. 1957. C. B. MacKenzie, Ed. International Business Machines Corp., 590 Madison Ave., N.Y. Quarterly. $3.50 per year.

The Journal of Solar Energy Science and Engineering, vol. 1, No. 1, Jan. 1957. Jean Jensen, Ed. Association for Applied Solar Energy, Suite 202, 3424 N. Central Ave., Phoenix, Ariz. $10 per year.

MD Medical Newsmagazine, vol. 1, No. 1, Jan. 1957. Felix Marti-Ibanez, Ed. MD Publications, 30 E. 60 St., New York. Monthly. Free to physicians; $7.50 year to others.

Newsletter, International Society of Aviation Writers, vol. 1, No. 1, Feb. 1957. Ross Willmot, Ed. International Society of Aviation Writers, International Aviation Building, Montreal, Canada.

Platinum Metals Review, vol. 1, No. 1, Jan. 1957. J. Bishop & Co., Platinum Works, Malvern, Pa. Quarterly.

Scientific World, vol. 1, No. 1, E. G. Edwards, Ed. World Federation of Scientific Workers, 27 Red Lion St., London, W.C.1. 2s. 6d. for 4 issues.

Smithsonian Contributions to Astrophysics, vol. 1, No. 1. *New Horizons in Astronomy.* Astrophysical Observatory, Smithsonian Institution. $1.50 (order from Supt. of Documents, GPO, Washington 25, D.C.).

Universitas, a German Review of the Arts and Sciences, English Language Edition, vol. 2, No. 2, 1957. H. Walter Bahr, Ed. Wissenschaftliche Verlagsgesselschaft, M.B.H., Stuttgart, P.O.B. 40, Germany. Quarterly. $4 per year.

Scientists in the News

Four Yale University faculty members in the medical and physical sciences will retire at the end of the current academic year: BERT G. ANDERSON, associate professor of surgery; ALAN M. BATEMAN, Silliman professor of geology; STUART R. BRINKLEY, associate professor of chemistry; and HERBERT S. HARNED, professor of chemistry.

Anderson, a dental surgeon, joined the Yale faculty in 1931. Educated at the University of Minnesota, where he received his D.D.S. degree in 1914, he taught in the College of Dentistry there for 8 years, with the exception of 6 months of duty as a first lieutenant in the Dental Corps of the U.S. Army. From 1920 to 1922, he specialized in oral diagnosis and oral surgery at the Earl Clinic in Minnesota and, from 1921 to 1922, was chairman of the oral diagnosis division of the College of Dentistry at the University of Minnesota.

He spent the next 7 years at the Peiping, China, Union Medical College, first as an associate in oral surgery and then as an assistant professor of oral surgery. He returned to this country as an associate professor of dentistry at Columbia University and joined the Yale faculty as an assistant professor of surgery in 1931. He was promoted to the rank of associate professor in 1940. Since 1931 he has been associate surgeon at the New Haven Hospital and New Haven Dispensary.

Bateman, known as one of the deans of economic geology and as a mining geologist of international reputation, first joined Yale as a part-time instructor in 1913. A native of Kingston, Ont., he received his B.S. degree from Queens University in 1910, and his Ph.D. degree from Yale in 1913. He was named an instructor in geology at Yale in 1915, and the following year he was appointed assistant professor. He became an associate professor in 1922, and was promoted to the rank of professor in 1925. He was named Silliman professor in 1941. Since 1946 he has been chairman of the department of geology.

The author of two books, *Economic Mineral Deposits* and *Formation of Mineral Deposits,* he has been editor of *Economic Geology* for the past 38 years, and was assistant editor for 2 years. The chief of the Metals and Minerals Branch of the Foreign Economic Administration from 1942 to 1945, he headed a special U.S. mission to Mexico to aid in the reconstruction of the Mexican mineral industry in 1941-42. He has served as a consultant to the National Security Resources Board, to the President's Materials Policy Commission, to the Office of Defense Mobilization, to the National Science Foundation, and to a number of other governmental groups. In 1949 he was in Tokyo, Japan, as a consultant on Gen. Douglas MacArthur's staff, dealing with the reorganization of Japan's mineral industry. His research has taken him on field trips all over the world.

Brinkley started teaching chemistry at Yale in 1918. A native of Augusta, Ga., he received his B.A. degree from Emory College, his M.A. degree from Columbia, and his Ph.D. degree from Yale. He was a teacher at the Presbyterial Institute in Blackshear, Ga., from 1909 to 1911, taught science and Greek at the Morris Harvey College in Barbersville, W.Va., from 1911 to 1913, and was on the faculty of the Michigan College of Mines from 1914 to 1918, when he went to Yale as an instructor in chemistry.

Brinkley was named an assistant professor of chemistry in 1921, and was promoted to the rank of associate professor in 1928. Primarily concerned with teaching, he has been head of the freshman chemistry program at Yale since 1924 and has served on the Freshman Course of Study Committee and the Freshman Rules Committee. His book *Principles of General Chemistry* has been published in four editions, while there have been three editions of another volume, *Introductory General Chemistry.*

Harned is a specialist in electrolytic and other chemical solutions. He received his B.A., B.S., and Ph.D. degrees

from the University of Pennsylvania, where he was an instructor in chemistry from 1913 to 1917, an assistant professor from 1917 to 1926, and a professor from 1926 to 1928. He went to Yale as professor of chemistry in 1928.

An officer in chemical warfare during World War I, he directed all atomic energy research in Yale's Sterling Chemistry Laboratory in World War II and was a group leader for the university's studies under the Manhattan Project. His research on diffusion in solutions is supported by contracts with the Atomic Energy Commission.

J. HOLTFRETER, professor of zoology at the University of Rochester, is delivering this year's Jesup lectures in the department of zoology at Columbia University. He has already given the first two lectures in the series, which is on "Form and action development." The other six will be delivered on 30 Apr., and 2, 7, 9, 15, and 16 May.

MARGARET MEAD, associate curator of ethnology at the American Museum of Natural History and a member of the AAAS board of directors, has joined the faculty of the University of Cincinnati College of Medicine as a part-time visiting professor of anthropology in the department of psychiatry.

A. H. STURTEVANT of California Institute of Technology, C. S. PITTENDRIGH of Princeton University, and CHARLES L. REMINGTON of Yale University will conduct a new course on genetics and evolutionary theory during the 30th annual session of the Rocky Mountain Biological Laboratory, Crested Butte, Colo., 1 July to 10 Aug.

ROBERT Q. THOMPSON, formerly an assistant professor of agricultural and biological chemistry at Pennsylvania State University, has joined the research staff of Eli Lilly and Company, Indianapolis, as a biochemist. He is engaged in the purification and characterization of antibiotic substances obtained from fermentation broths. In addition, he is responsible for studying certain nutritional factors in small animals and poultry.

R. DUNCAN LUCE, applied mathematician, and ROBERT W. RAPOPORT, social anthropologist, will become lecturers on social relations at Harvard University on 1 July. Luce, now directing a research project at the Bureau of Applied Social Research at Columbia University, has applied mathematical analysis to the study of behavior in small groups and to the theory of games. He is an assistant professor in mathematical statistics and sociology.

Rapoport, who is at Cornell University, will work with a mental health training program at Harvard, jointly sponsored by the Harvard Medical School, the School of Public Health, and the Laboratory of Social Relations. Earlier, he did field work in Navajo communities of the Southwest. He is coauthor of a forthcoming book on *Community as the Doctor.*

EUGENE E. HOWE, biochemist who has been with Merck and Company, Inc., since 1941, has been appointed director of nutrition for the Merck Institute for Therapeutic Research. Howe's promotion follows the resignation of GLADYS A. EMERSON, who accepted a full professorship at the University of California, where she will head the home economics department.

WILLIAM M. CLARK, professor emeritus, department of biological chemistry, Johns Hopkins University School of Medicine, has been selected as the recipient of the $5000 Passano Foundation award for 1957. On 5 June, during the week of the American Medical Association convention in New York, an award dinner will be held at the Waldorf-Astoria Hotel in honor of Clark. Clark is being recognized for his long and distinguished career as investigator and teacher and for his demonstration over the years of the importance of physical methods, notably in the control of *p*H and of oxidation-reduction, to the study of life-processes.

RUTH C. CHRISTMAN, editor of the AAAS symposium volumes, has resigned as editor of Interscience Publishers, New York, to resume her activities as free-lance editor and publishing consultant.

C. J. MOSBACHER, JR., has been appointed managing editor of Interscience. He was formerly managing editor of *Nucleonics* magazine and a consultant on atomic energy for the United Nations, where he supervised publication of the 16-volume *Proceedings of the International Conference on the Peaceful Uses of Atomic Energy.*

JOSEPH PISANI has resigned as assistant dean of the State University of New York College of Medicine in Brooklyn to become medical director of the Bankers Trust Company, New York.

Important organizational changes in the staff at Oak Ridge National Laboratory have been announced. E. D. SHIPLEY, assistant director of ORNL, has been appointed director of the newly formed Thermonuclear Experimental Division, and A. H. SNELL, director of the Physics Division, has been appointed assistant director of the laboratory.

J. L. FOWLER, associate director of the Physics Division, will succeed Snell as director of the division. P. R. BELL, also a member of the Physics Division, will become associate director of the Thermonuclear Experimental Division.

ISADORE PERLMAN has been named chairman of the department of chemistry in a reorganization of the College of Chemistry on the Berkeley campus of the University of California. In the past the college has contained a single department of chemistry and chemical engineering and a division of chemical engineering. KENNETH PITZER has held the dual post of dean of the college and chairman of the department. CHARLES R. WILKE has been chairman of the division of engineering.

Under the reorganization there are two departments. Pitzer continues as dean of the college, with Perlman chairman of the department of chemistry and Wilke chairman of the department of chemical engineering.

Recent Deaths

WILLIAM M. ADAMS, Memphis, Tenn.; 51; head of the department of plastic surgery at the University of Tennessee Medical School; 4 Apr.

EVELIO L. BARRENA, Havana, Cuba; 57; subsecretary of health and a professor at Havana University; 2 Apr.

C. BEVERLEY BENSON, Hartsdale, N.Y.; 61; consulting engineer; 2 Apr.

ROBERT L. BENSON, Portland, Ore.; 76; professor emeritus of medicine at the University of Oregon School of Medicine.

ROBERT W. BRIGGS, Rye, N.Y.; 69; consulting engineer; former associate professor at Columbia University; 5 Apr.

HOMER C. FRITSCH, Grosse Pointe Park, Mich.; 62; analytical chemist and executive vice president and a director of Parke, Davis and Company; 8 Apr.

ARTHUR W. GRAY, Westfield, N.J.; 82; former research physicist for the National Bureau of Standards; 6 Apr.

THOMAS H. MACDONALD, College Station, Tex.; 76; retired chief of the Bureau of Public Roads and Distinguished Research Engineer at Texas Agricultural and Mechanical College; 7 Apr.

ROLAND H. PATCH, Storrs, Conn.; 68; retired professor of floriculture at the University of Connecticut; 9 Apr.

FRANK M. SIMPSON, Lewisburg, Pa.; 84; professor emeritus of physics at Bucknell University; 10 Apr.

LEONID A. UMANSKY, Schenectady, N.Y.; 66; retired manager of industrial engineering for General Electric Company; 3 Apr.

MIKHAIL M. ZAVADOVSKY, Moscow, Russia; 66; research biologist; announced 30 Mar.

Book Reviews

Science in the Federal Government. A history of policies and activities to 1940. A. Hunter Dupree. Belknap Press of Harvard University, Cambridge, Mass., 1957. x + 460 pp. Illus. $7.50.

The years that are fresh in memory have seen the development, the solution, and sometimes the failure of solution of many a problem concerning the relations between science and the Federal Government, including the wartime concentration of scientific effort in the Office of Scientific Research and Development, the struggle to secure legislation establishing the National Science Foundation, problems of security and loyalty screening, the birth of the Atomic Energy Commission, and the debates over the proper roles of government and industry in the development of atomic power. Without discussing a single one of these contemporary or recent matters, Dupree contributes profoundly—and frequently entertainingly—to an understanding of the administrative, organizational, and policy problems that underlie them. He provides a background, from the Constitutional Convention in 1787 to the outbreak of World War II, of information on the continuously evolving relations between science and government and the unending effort to develop appropriate policy bases for those relationships. The author, a historian now at the University of California at Berkeley, has produced an original, comprehensive, and excellent history that not only tells a fascinating story but also adds greatly to our depth of understanding of the complex relations between science and government.

One of the debates of the Constitutional Convention centered on the proper role of the Federal Government in encouraging learning in the arts and sciences. Powerful voices—Franklin, Madison, Pinckney, and others—wanted the new constitution to give explicit recognition to these obligations. The opposition was not primarily to science and learning per se but to a strong central government. In the end, the dreams of some of the founding fathers of a national university, and of explicit responsibility for fostering science and the arts, were casualties of a majority belief that responsibility for internal improvements belonged to the states and not to the Federal Government.

The theme that runs all through Dupree's book is that the issue debated in the Constitutional Convention has never been settled. Franklin and Madison and Pinckney had as their spiritual heirs every President through John Quincy Adams and, in a later time, Presidents Theodore Roosevelt, Herbert Hoover, and Franklin D. Roosevelt, as well as numerous scientists, bureau chiefs, and scientific organizations. The defenders of the doctrine of states' rights have also had their spiritual heirs, sometimes in the White House, more frequently in Congress, and occasionally among the ranks of leading scientists. Since George Washington's first term as President there has been a continuous effort to resolve the basic problem of federal responsibility and to develop organizational relationships that will allow government to serve science and science to serve the general welfare.

As a consequence of this continuing debate, many of the existing federal scientific activities had to come in through the back door. When Congress was unwilling to adopt legislation that clearly established a scientific agency and defined its function, which was usually the case, it was frequently possible to foster a scientific activity by tacking a rider onto an appropriation bill. When President Jefferson arranged for the Lewis and Clark expedition (which made substantial contributions to several branches of science), a double stratagem was necessary: from the Spanish Government he secured permission for an exploratory party that would "have no other view than the advancement of geography," but, in approaching Congress, which would not have appropriated a penny for the study of geography, he justified the expedition on the grounds of its commercial possibilities. When Congress showed almost complete apathy toward creating the National Academy of Sciences, it was possible for one Senator to slide through an unread bill on the hurried final afternoon of a Lame Duck Congress, thus circumventing the opposition both of Congress and of the nation's leading scientist, Joseph Henry. Dupree defends these stratagems, pointing out that they were not examples of political immorality but necessary consequences of ignorance of science on the part of most Congressmen and of the technical difficulties of legislating scientific bureaus into existence through the ordinary Congressional machinery.

Along with the continuing thread of effort to find solutions to organizational and legislative problems, there is much of specific interest concerning the origins and changing fortunes of federal agencies that now seem to occupy assured and stable positions, the National Bureau of Standards, the Department of Agriculture, the Forestry Service, the Geological Survey, the National Institutes of Health, the Smithsonian Institution, and others; of some that lived for a while and then went out of existence, the Allison Commission, the Bureau of Science in the Philippines, the Science Advisory Board; and of one that never came into existence but that was frequently and sometimes strongly advocated, the Federal Department of Science.

Here, too, are odd bits and interesting sidelights of scientific history. Until 1853 every director of the Bureau of the Mint had some kind of scientific background; in 1805 Jefferson refused to appoint Benjamin Rush to that position because of his lack of training in mathematics. One of the earliest federal research grants to a private institution was in 1830, when the Franklin Institute was asked to study the causes of explosions of steam engines. The balloon observation program of the Army of the Republic was abandoned, not because of technical difficulties, but because of "failure of the Army to incorporate a new procedure into its operations."

The whole history is enlivened and frequently made dramatic by the skillful portrayal of the personalities of major participants and the re-creation of the attitudes, the clash of opinions, and the current problems that shaped their thinking and determined their successes and failures.

DAEL WOLFLE
American Association for the Advancement of Science

The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent. Held at Alpine Rose Lodge, Brighton, Utah, 27–30 Aug. 1955. Calvin W. Taylor, Principal Investigator. University of Utah Press, Salt Lake City, 1956. 268 pp.

Most of us have had the experience of attending stimulating conferences and of reading, later, the reports of those conferences only to find that the brilliance of the original discourse had become dull and tarnished somewhere between the speech-making and the printing of the report. However, readers

of this report will be pleasantly surprised to find that this document is a successful attempt to reproduce the freshness of spirit which is found when a dozen or more brilliant individuals are assembled for the purpose of struggling with an exciting intellectual problem. I found that once I had started reading the report I could not put it down.

The basic material on which the report is based consists of 16 papers presented at the conference with varying degrees of formality and a very large amount of spontaneous discussion. The contributors, in editing their own discussion reports, have successfully retained those portions of the discussion which add significantly to the development of ideas presented within the papers themselves. In order to accomplish this purpose, discussion is freely reproduced within the text of many of the papers. Thus, each section of the report presents considerable continuity of ideas and a degree of organization which is usually lacking in such reconstituted material.

It is not feasible here to discuss the content of particular contributions. These vary from highly organized presentations, such as that of Guilford on the structure of human abilities, to speculative and free-flowing presentations which are highly imaginative even if they are not supported by any data.

A valuable feature of the work is a series of reports of committees, which are reproduced in a concluding section. The committees have been successful in gathering together the major ideas presented in the earlier reports and discussions. These committee reports are presented in the same informal manner as the rest of the material and are interspersed with the comments of the audience to which the committee reports were presented.

A final bibliographic section rounds out the report by providing a list of 131 references to which the reader may turn to find support for much that was presented earlier. All in all, one may expect that this report will be considered a major reference work in the area for at least a decade to come.

ROBERT M. W. TRAVERS
Air Force Personnel and Training Research Center

Biographical Memoirs of the Fellows of the Royal Society. vol. 2, 1956. The Royal Society, London, 1956. 345 pp. Illus. + plates. 30s.

This is the second volume of a new series of brief biographies that is a continuation of the *Obituary Notices of Fellows of the Royal Society (1933–1955)*. As in the first volume and as in the older series, each article is accompanied by a full-page photograph or portrait of the subject and a complete bibliography of his publications. The articles, which describe the lives and principal scientific accomplishments of the subjects, maintain the standard of excellence of the older series.

Biographies of the following are presented: Walter Sydney Adams, Gleb Anrep, Oswald Theodore Avery, Henry Frederick Baker, Patrick Alfred Buxton, Sheldon Francis Dudley, Lewis Leigh Fermor, Alexander Fleming, William Michael Herbert Greaves, Arthur Lewis Hall, Henry George Albert Hickling, Harold King, Charles James Martin, John William Nicholson, Robert Cyril Layton Perkins, Richard Friedrich Johannes Pfeiffer, Alexander Oliver Rankine, Sigmund Otto Rosenheim, John Alexander Sinton, William Kingdon Spencer, Edmund Taylor Whittaker, and Robert Williams Wood.—G. DuS.

Dahlak. With the Italian National Underwater Expedition in the Red Sea. Gianni Roghi and Francesco Baschieri. Translated from the Italian by Priscilla Hastings. Eleanor Brockett, Ed. Essential Books, Fairlawn, N.J., 1957. 280 pages. Illus. + plates. $6.

The members of this expedition spent 6 months off the southwestern shore of the Red Sea, among an archipelago of which Dahlak was the largest island. Headquarters was a 135-ton motor vessel. The staff, eight in number, was divided equally into scientific and "sports" groups, but this volume deals almost entirely with the activities of the latter—their failures, successes, and especially their narrow escapes. These sportsmen were armed with shotguns, rifles, arrows, lances, harpoons, spear-guns, and dynamite. They were outfitted with goggles, compressed-air respirators, and fins. It is, thus, the most recent of a long list of volumes dealing with encounters with, and dangers of, the eternal barracudas, mantas, moray eels, and especially sharks. The authors claim that these "direct" methods take precedence, in collecting and scientific results, over the old-fashioned nets and hooks. As proof, they tell of 53 tanks of Formalin, containing 800 pounds of fish and quantities of invertebrates.

Scattered throughout the text are hints of the neglected or half-seized opportunities for behavior observation. Even these notes are negatived by superficial descriptions, lack of identification, and complete absence of an index.

The account of the parturition dance of the mantas is intensely interesting but would have had great significance if the observers could have distinguished and verified the characteristics of newborn mantas. Many cowries were collected, but apparently not a note or painting was made of the complex patterns and coloration of the owners of these shells. Nearly 2 months were spent in search and capture of the strange fish Cefalone. The notes would have been of real value if, before publication, a photograph of the fish had been sent, for naming, to some competent Italian ichthyologist.

A human being, kicking and swimming his way under water from reef to reef and brandishing lethal weapons, has little chance of making worth-while observations. A man running through the jungle, waving arms and legs, could not expect the birds and animals to behave in a natural manner. It is high time that an expedition was given over to trained scientific observers, armed with waterproof paints, paper, and pencils. The results would be beyond any expectation. There is much to be said for the old-fashioned diving helmet, tethered by a hose.

Francesco Baschieri has contributed an appendix which consists of a brief geologic history of the Red Sea, an account of former expeditions, and short generalized paragraphs on groups from plankton to mammals. Some of the photographs are excellent.

WILLIAM BEEBE
New York Zoological Society

American Men of Science. A biographical directory. vol. III, *The Social and Behavioral Sciences.* Jaques Cattell, Ed. Bowker, New York, ed. 9, 1956. 762 pp. $20.

American Men of Science is edited by Jaques Cattell, son of the late James McKeen Cattell, who in 1906 issued the first edition of this directory, which has become an indispensable tool to scientists everywhere.

The present edition is divided into three volumes, of which *The Social and Behavioral Sciences* is the third. This volume contains names of individuals in some fields not included in the eighth edition, published in 1949. Psychologists, geographers, and anthropologists were dealt with in earlier editions, but, in addition to these categories, the present volume also lists workers in the social sciences, some of whom were previously included in the *Directory of American Scholars.* It was originally planned to list historians in the present volume. On advice of the American Historical Association, however, it was decided to omit historians here and include them in the forthcoming new edition of the *Directory of American Scholars.*

The eighth edition of *American Men of Science* contained some 50,000 biographies, which made a book that pressed

the danger point of binding as a single volume. This led to the decision, since the present edition might contain in all more than 90,000 names, that it should be issued in three volumes: volume I, *The Physical Sciences*; volume II, *The Biological Sciences*; and volume III, *The Social and Behavioral Sciences*. From the standpoint of optimum convenience, it is unfortunate that all American men of science can no longer be listed in a single volume. This is, of course, a commentary on the Gargantuan growth of American science in the past half-century: even the mechanics of modern printing and binding cannot keep pace with it.

The preparation of three volumes for the listing of present-day scientists led to difficult decisions concerning which volume was most appropriate for some individual listings. For example, medical scientists are included in *The Biological Sciences*, and, since psychiatrists are medical men, their names appear in this volume. This is true even in the case of psychiatrists primarily interested in "social psychiatry" and the social sciences in general. On the other hand, most psychologists appear in *The Social and Behavioral Sciences*. This means that, except for a handful of experimental psychologists who are active in various biological scientific societies and, hence, appear in volume II, most of the physiologically oriented psychologists of the country appear in *The Social and Behavioral Sciences*. A similar comment may be made in regard to some geographers. These statements are not made in criticism of the classifications used in the three volumes, because such problems are inevitable when an editor must deal with the classification of research men and scholars according to named areas of research.

The biographies are presented in a standard form. The criteria on which names are included and the biographical facts given are, as the present editor points out, very similar to those used by his father in the first edition, 50 years ago. An excellent table of abbreviations is given.

Considerable care has been exercised by the editor to provide the type face and the spaces necessary to make the material presented in this well-bound book as legible as possible, in view of the need for economy of paper that was, of course, paramount.

The scientific and academic world owes the editor of this volume and of the two preceding volumes of the ninth edition a debt of gratitude. He has performed a notable service for the American learned world in issuing, in convenient form, this large and valuable work of reference.

LEONARD CARMICHAEL
Smithsonian Institution

British Scientific and Technical Books. A selected list of recommended books published in Great Britain and the Commonwealth in the years 1935–1952. Published for Aslib. Clarke, London; Hafner, New York, 1956. 364 pp. $11.25.

This bibliography includes "the most important and useful books on science and technology published in the United Kingdom and the Dominions between 1935 and 1952." Books in the pure and applied sciences are included, together with those publications in psychology, documentation, architecture, and photography that are deemed to be of interest to technical readers. Economic and social sciences have been excluded, and such scientifically peripheral subjects as gardening and domestic science are covered less thoroughly than are the strictly technical subjects. The main body of the bibliography is arranged according to the Universal Decimal classification. In addition, there are author and title indexes and there is a list of publishers.

UNESCO Source Book for Science Teaching. United Nations Educational, Scientific, and Cultural Organization, Paris, 1956. 222 pp. Illus. $3.

This book, which is essentially a laboratory manual for elementary science instruction, is an outgrowth of a UNESCO book prepared by J. P. Stephenson, science master at the City of London school, shortly after the end of World War II under the title *Suggestions for Science Teachers in Devastated Countries*. The original went through several editions and was translated into French, Spanish, Chinese, Thai, and Arabic. The experience of science teachers sent into the field by UNESCO led to the devising of new experiments and the adaptation of new materials for science instruction.

The book abounds in examples of the ingenious transformation of the refuse of civilization into usable, even though crude, laboratory instruments. These, supplemented by a few tools and inexpensive materials from the hardware store, the grocery, and the drugstore, suffice to permit a wide range of experiments, especially in elementary physics. Adherents of the sealing-wax-and-string school of laboratory practice will be delighted to see how much can be done with simple materials: "spring" balances from rubber bands or old automobile cushion springs; tripods, heaters, air ovens, and steam baths from tin cans; a Liebig condenser from an iron pipe, corks, and a glass tube; tweezers from strap iron; a sextant from bits of cork, strips of wood, pieces of silvered glass, and a protractor; an aneroid barometer from a glass jar, a sheet of rubber, and a broom straw; used bottle caps tacked to a board in such a way that they intermesh to form a train of gears, and so on.

In addition to instructions for the preparation of apparatus and suggestions for experiments, there are general suggestions for teaching and there are appendixes of weights and measures, stars and planets, the elements, rocks and minerals, densities, heat constants, relative humidity, the Greek alphabet, and a list of source books and periodicals.

Although the book is directed to the secondary school, anyone concerned with science teaching, from the grade school to the university, should find some interesting ideas that he could adapt to his laboratory teaching. Perhaps the most wholesome effect the book will have in this country is to demonstrate that a piece of equipment does not have to be chrome-plated to be useful. The book may be obtained from the UNESCO Publications Center at 152 W. 42 Street, New York 36.—G. DuS.

Biology and Medicine

A World Geography of Forest Resources. Stephen Haden-Guest, John K. Wright, and Eileen M. Teclaff, Eds. for the American Geographical Society. Ronald Press, New York, 1956. 736 pp. Illus. + plates. $12.50.

This handsome volume, *A World Geography of Forest Resources*, appears as a successor to the classic work by Zon and Sparhawk, *Forest Resources of the World*, published in 1923 and now both out of print and out of date. Unlike its predecessor, the present work is the fruit of specialized labor. It includes contributions from 35 authors, the majority from outside the United States. The editors have been generally successful in encouraging contributors to address themselves to a common purpose.

The purpose appears to be twofold: to provide a general and cosmopolitan summary of the relationship between forests and man and to furnish more detailed accounts of forests in each nation or region of the world. Introductory chapters deal with the importance of forests to man and with forest influences, the principles and practice of forestry, and the forest products industries. The outstanding contribution to this general section—partly, perhaps, because of its greater length—is Wendell Camp's "The forests of the past and present." In this chapter, Camp presents a splendid account of the development of forest vegetation through geologic time, in the light of a critical reading of the paleobotanical record.

The major portion of the volume is devoted to the 25 chapters concerned with national or regional forests. These chapters, naturally, vary in scope and quality, in part because of the varying concerns of the authors and in part because of the great diversity of forests and culture that marks the modern world. The typical chapter includes brief accounts of physical geography, the major forest associations, the history of forests and their present condition, wood-using industries and their impact on forests, and the development of forest policy and management. Some authors consider the ecology and successional relationships of important species and types; others touch on these biological matters only slightly or not at all.

Since the publication of Zon and Sparhawk's work, quantitative information about forests has multiplied, especially information on the extent and merchantable volume of commercially accessible areas and species. But the authors of the present volume have wisely minimized the presentation of detailed tables. These the interested reader can readily consult in the statistical publications of the United Nations Food and Agriculture Organization.

It is hard and perhaps unfair for the untraveled reviewer to cite chapters that are especially successful as regional accounts. But any such list, I believe, would have to include the chapters on middle America, western Europe, the Mediterranean, tropical Africa, the U.S.S.R. (by the late Raphael Zon), Japan, and Oceania.

At the end of the volume is a final, general essay, "The outlook for the world's forests and their chief products," by Erhard Rostlund, a geographer on the faculty of the University of California. This essay, despite occasional slackness of statement and organization, is a brilliant and stimulating discussion. Rostlund examines and challenges many of the facile shibboleths often found in the pages of popular and technical literature: that presently inaccessible forests will be developed to answer all the world's needs; that "the half-promise of technology" will enable us to recoup, in the factory, what we have lost on the land; and that silviculture, aided by genetics, will soon permit us to manipulate forest stands as readily as we manipulate field crops. Rostlund may exaggerate the extent to which these and other illusions affect our attitudes toward the forest resource. Yet he has set up no straw men, and his discussion, at the least, should help us to place some current fads in proper perspective.

The contributors, editors, and publisher deserve credit for supplying a section of 110 excellent photographs, which illustrate the great variety of species, sites, and cultural environments involved in the concept of "forest."

The serious reader is not so well served, however, if he wishes to use this book as a starting point for further investigation. Eileen Teclaff's seven-page bibliographic note at the end of the volume is a good start, but it leaves many important gaps. Most of the regional chapters supply no more than a few citations on nomenclature. It is unfortunate that the editors did not insist on more adequate documentation and references for these chapters and thus make this excellent compendium even more useful.

HERBERT I. WINER
School of Forestry, Yale University

Theoretical Genetics. Richard B. Goldschmidt. University of California Press, Berkeley, 1955. x + 563 pp. Illus. $8.50.

This book treats of questions pertaining to the nature of the genic material and its action. Richard Goldschmidt, who in his experimental work and in his earlier theoretical discussions has made a large number of major contributions to our understanding of these problems, considers, in the present book, the status of his earlier ideas in the light of the recent evidence and discusses a number of questions which have arisen since his last book was written.

Theoretical Genetics is directed to the specialist in genetics, and its purpose is to present the point of view of the author to his colleagues and to support it with the available evidence. The book contains an extensive bibliography (50 pages), but it is not a review or a textbook in the usual sense, since it does not attempt to describe the material contained in the papers quoted. Frequently the experimental material contained in the papers is supposed to be known to the reader and is simply adduced to support the argument of the author. In other cases, the work is presented extensively and critically in its relation to the conceptual framework developed in the book. The book is conspicuous, in the biological literature, for the large number of verbatim quotations from the papers of other geneticists. These quotations usually embody the conclusions to which the other authors have come concerning the questions discussed. They serve, then, in the Aristotelian manner, as a starting point for Goldschmidt's development of his own ideas.

The book is divided into five parts of which the last two are relatively short, whereas the first three make up the bulk of the work. The arguments in all parts are closely interconnected, and cross references are accordingly frequent. The first part deals with the nature of the genetic material. Mutation is assumed to represent a change in the pattern of the genic material, and this picture leads the author to represent the organization of the chromosome as consisting of overlapping segments of genic material which, in turn, are overlaid by patterns of a higher order, so that a hierarchical order of organization of the genic material results. After thorough review of the evidence, Goldschmidt arrives at the conclusion—different from that of the great majority of geneticists—that the genic material is represented by the protein constituents of the chromosome, and that the DNA has a function necessary for the self-reproduction of the genic protein material.

The second part of the book deals with the function of the cytoplasm. The author denies a genelike activity of cytoplasmic components and regards the cytoplasm as a more or less specific substrate for genic action. For this reason he rejects the term *plasmagene* as misleading, since the self-reproducing cytoplasmic constituents do not show the specific effects on developmental processes characteristic of genes.

The third part discusses the action of the genic material. The emphasis here is on genic action in the development of higher organisms rather than on the control of biochemical activities, derived mainly from the study of microorganisms. Goldschmidt points out that, for the control of developmental processes, one of the fundamental modes of action to be postulated for the genic material is "stratification"—that is, the orderly arrangement of materials in the cytoplasm. Furthermore, genes must be assumed to control the speed of developmental processes and the thresholds involved in determination and differentiation, as was pointed out by the author in his earlier work.

The final two chapters contain applications of the viewpoints presented on the balance theory of sex determination and on the author's well-known theory of the origin of higher taxonomic categories by "macromutations"—that is, fundamental changes in the pattern of genic organization.

Most geneticists will disagree with some of the points made in the course of the discussion, and the main disagreements will be different for different geneticists. In this connection, it should be remembered that many of Goldschmidt's views which, when first proposed in his earlier works, were disputed by the majority of his colleagues have in the intervening time found widespread acceptance.

It is impossible, in a short review, to give more than a slight indication of the

direction in which the argument of the book tends. The wealth of material covered, the large number of issues considered, and the critical way in which the material is treated will make the book highly rewarding and stimulating reading for every geneticist. The manner in which concepts of genetics which have become widely accepted are challenged will induce the reader to reevaluate the evidence on his own and to establish his own position more firmly. In this way, the book is certain to contribute to the clarification of the fundamental concepts of genetics and to play a large role in the future development of the science.

ERNST CASPARI
Center for Advanced Study in the Behavioral Sciences

The Dentition of the Australopithecinae. Transvaal Museum Memoir No. 9. J. T. Robinson. Transvaal Museum, Pretoria, 1956. 179 pp. Illus.

Since the finding of a single juvenile skull in 1924, the discovery of australopithecines in South Africa has accelerated remarkably. Amid all the polemics, it has also become increasingly evident that these creatures give crucial evidence on human origins. Now J. T. Robinson, able successor to the late Robert Broom, has published data on no fewer than 526 teeth (many isolated, but many associated in skulls or jaws), which come from five localities and represent the entire dentition, both deciduous and permanent.

The value of this contribution, even on the descriptive level, can hardly be overemphasized. Measurements and elementary but useful statistics are given for all the samples. Representative teeth are clearly figured, chiefly by photographs twice natural size. Verbal description is sufficiently detailed and comparative. Taxonomy within the group now achieves a sound basis. Robinson clearly demonstrates that the five locality samples represent two, and only two, well-distinguished taxa, which he prefers to call genera: *Australopithecus* and *Paranthropus*. Whether these are, indeed, best called genera and whether each includes two or more distinguishable local populations are relatively unimportant questions, in part matters of taste and in part a subject that requires still more extensive analysis. (A third group, Robinson's *Telanthropus*, is regarded by him as truly hominine and is omitted from the present study.)

The accumulated evidence is now overwhelmingly in favor of hominid affinities for the australopithecines. There are strong diagnostic differences between the dentitions of pongids (true apes) and hominids (true humans and strictly manlike forms), and in almost every important dental character the australopithecines are more like the hominids than like the pongids. In connection with the skeletal evidence, here mentioned but not spelled out, this surely indicates that australopithecines are more nearly related to the typical human than to the typical ape stock. It is also clear that the australopithecines are in many respects more primitive than the higher or unquestioned human beings (hominines, technically) and that they display some, at least, of the characteristics possessed by our own ancestry at stages more remote than, for example, Java man (*Pithecanthropus*).

These are the more important conclusions that may now, after a whole generation of fierce dispute, be taken as definitive. The exact taxonomic expression of these facts will always be open to some disagreement and will eventually depend on phylogenetic details that are not yet cleared up. Robinson now grants that the known australopithecines are too recent to be directly ancestral to *Homo* in any strict sense. He considers his *Australopithecus* and *Paranthropus* to be two divergent lines that probably evolved contemporaneously with each other and with still another divergent line that was to eventuate in *Homo*. The two recognized australopithecine lineages are supposed to have evolved at different rates, *Paranthropus* more slowly, and thus to represent (in general, not in all details) successive structural stages in the rise of the hominines.

Here an alternative hypothesis may be suggested. *Paranthropus*, the less hominelike group, seems, on present evidence, to be later in age than *Australopithecus*, and both are probably contemporaneous with true hominines. It is more consistent with this evidence and at least as consistent with the morphologic facts to consider *Australopithecus* and *Paranthropus* to be essentially successive stages in the evolution of nonhominine stocks derived from prehominines. Then *Paranthropus*, the later group, would be not structurally more primitive but more specialized divergently away from the hominines and might even, to some extent, be convergent toward the apes. *Australopithecus*, which is in fact more manlike, would be phylogenetically nearer to the split from the prehominines. The characteristics of the true human ancestry would be more nearly approximated by projecting backward from *Paranthropus* through *Australopithecus*, not in the reverse direction, as Robinson tentatively suggests.

Even when they may not offer the only possible or perhaps most probable explanation, Robinson's interpretations are worthy of close attention. The data that he presents constitute one of the greatest contributions ever made to the vexatious problem of our own origins.

G. G. SIMPSON
American Museum of Natural History

Animal Navigation. How animals find their way about. J. D. Carthy. Scribner's, New York, 1956. 151 pp. Illus. + plates. $3.95.

The observed facts of, and in some cases the fancies about, animal navigation have long mystified scientists and laymen alike and have frequently been blanketed with the terms *instinct* or *sixth sense*. With the flourishing of sensory physiology and the invention of mechanical devices which enable human beings to apprehend certain physical phenomena, such as polarized light, which were previously obscure to man's senses, some of the mysteries of animal orientation are being unraveled. The understanding of the orientation of bats by echolocation, for example, awaited the invention of an acoustic system which is sensitive to high-frequency sound, despite the fact that Spallanzani, in the late 18th century, had gathered strong (although not so interpreted) experimental evidence for acoustic orientation. A chasm, in part technologic and in part intellectual, lay between the experimental observation of an association between unobstructed hearing and oriented flight and the clear appreciation that sound which is inaudible to man is the information-carrying medium.

J. D. Carthy, in *Animal Navigation*, deals briefly with the investigations of orientation in a variety of lower invertebrates, arthropods, fish, birds, and mammals. The coverage is broad and, as a result, sometimes superficial or noncritical. Many ingenious and beautifully designed experiments are, however, woven into a book, with a great deal of charm and understanding. Although very few of the observations or experiments are reported in sufficient detail to permit the reader the pleasure of evaluating the conclusions himself and to reveal the full scope of the problem that is presented or of the ingenuity that is involved in its solution, Carthy uncovers for those not yet initiated a truly fascinating world of specialized senses and, indeed, of senses not yet identified, and he draws examples from a very wide background. A short list of suggested books is included. A brief bibliography would have been very welcome.

This is a light and pleasant introduction, free from sensationalism, to the fields of sensory physiology and behavior. It should provide provocative reading for laymen and investigators of other

disciplines and should, also, make fine supplementary reading for students in introductory zoology courses. Scholarly but popular surveys, such as this, of appropriate areas of the natural and physical sciences are increasingly welcome.

ALVIN NOVICK
Harvard University

The Open Sea. The world of plankton. Alister C. Hardy. Houghton Mifflin, Boston, 1956. 335 pp. Illus. + plates. $6.50.

There have been so many books about the sea and its life, especially in recent years, that it seems impossible that anything new could be said, or that it could be said in a fresh and stimulating way. But Alister Hardy (of Oxford University) has somehow achieved the impossible and has written a book about the sea that reads as if it had been written fresh on the morning of discovery. The enthusiasm with which he approached his task is the key, of course, and it is his ability to convey his enthusiasm without lapsing into purple or mauve patches that makes his book both good reading and sound science. Even the details in small type are full of delightful surprises. Of course, as a zoologist, I may take more delight in some of these than a physical oceanographer would, but perhaps it is he who has permission to skip the small type.

Although the book is primarily about the sea around the British Isles and the plant and animal life found within it, many of the organisms discussed are similar to, if not the same as, those in other parts of the world. Thus, while the addition of a few more examples exotic to the British Isles would have increased the value of the book for American readers, there are enough similarities to make it a valuable and useful introduction to the study of plankton anywhere. It could even serve as a good textbook for introductory courses. The chapters on pelagic larval forms, vertical migration, and deep-sea life are of universal application, and it is refreshing to see so much good, sound zoology here and throughout the book.

There seems to be one school of scientific popularization that holds that readers are not interested in details and that they should be offered only the broad outlines of a subject and not be confused by being presented with both sides of controversial matters. The contributions of this school are usually written by people who are professional writers—or popularizers—rather than scientists, and all too often there are indications that the writer has extended himself beyond the limits of his information without being willing to admit as much. The other school of popularization, of which this book is a splendid example, holds only to the premise that the author should be an expert on the subject he chooses to discuss, and that he is the judge of how best to present it.

Hardy has worked with plankton for more than 30 years and is one of the best known experts in the field. We are fortunate, therefore, that he was willing to write this book and that he found time to add to it the personal touch of his own paintings. Indeed, we are doubly fortunate, for a second volume, on the fisheries, has been promised.

In reading this book, I have had but one regret—that it could not have been the first to introduce me to the open sea and its life.

JOEL W. HEDGPETH
Scripps Institution of Oceanography

Rauwolfia: Botany, Pharmacognosy, Chemistry and Pharmacology. Robert E. Woodson, Jr., Heber W. Youngken, Emil Schlittler, and Jurg A. Schneider. Little, Brown, Boston, 1957. 150 pp. Illus. + plates. $5.50.

About 25 years ago, chemists and pharmacologists in India began to study crude extracts of the old Indian drug *Rauwolfia serpentina*. As a result of this interest, *Rauwolfia* was recently introduced into Western therapeutics and, in less than half a dozen years, not only has become a widely used agent itself but has introduced the concept of tranquilizers to medicine. At the same time that the clinical uses were being explored in hypertension and in the psychoses, further extensive botanical, chemical, and pharmacological work was inspired, and it is the latter fields which are considered in this book. The discussions are straightforward approaches from each of the disciplines concerned and, in places, are quite technical. The book's appeal is therefore to the serious worker rather than to the casual reader.

The first section deals with the botany of *Rauwolfia* and its relatives. The genus is widely tropical in distribution and is not found naturally in Europe or the United States. An intense search has been made for related species high enough in alkaloidal content to be commercially profitable. Both *Rauwolfia vomitoria*, from Africa, and *Rauwolfia tetraphylla*, from tropical America, are being exploited and may prove to be satisfactory species for cultivation.

The second section of the book is on pharmacognosy and describes the physical characteristics, histology, and crude-drug characteristics of the various species.

The third and most extensive section deals with the chemistry of the many *Rauwolfia* alkaloids. In 1952, Emil Schlittler, the author of this section, together with Mueller and Bein, reported the isolation of reserpine, an indole alkaloid, from the crude drug. This was the first alkaloid which showed the typical properties of the whole drug and has, in large part, replaced the crude extracts in medicine. More recently, two other pure alkaloids with reserpinelike actions have been isolated: rescinnamine and deserpidine. Reserpine has been synthesized by an elegant procedure of some 20 steps.

The last section deals with the pharmacology of *Rauwolfia*. The actions of about 30 of the alkaloids are described briefly, and those of reserpine, extensively. This drug has been called phrenotropic, because it influences the function of the mind. Although complex, the influence is in the direction of sedation or depression but toward tranquility rather than toward sleep. The body temperature tends to drop, the blood pressure to be lowered, the pupils to narrow, and the respiration to be slowed. By contrast, the gastrointestinal tract shows increased activity. These actions appear to result largely from a somewhat specific depression of central sympathetic tone. A rather striking biochemical concomitant is a profound serotonin release from the tissues, especially of the central nervous system. Therapeutic use is not discussed in any detail.

Reserpine has high interest, both for its own effects and because it opens new doors of investigation in the field of neuropharmacology, and this book will, accordingly, be most welcome to workers in these fields.

WINDSOR CUTTING
Stanford Medical School

Pharmacognosy. Edmund N. Gathercoal and E. H. Wirth. Revised by Edward P. Claus. Lea and Febiger, Philadelphia, ed. 3, 1956. 731 pp. Illus. + plates. $12.50.

In this edition, Edward P. Claus has ably revised and modernized a justly popular textbook. Classification of plant and animal drugs on the basis of their chemical constituents replaces the previous taxonomic classification, in accord with changing trends in pharmacognosy, with the progressive deemphasis of botanical subject matter in the pharmaceutical curriculum, and with the later thinking of the original authors.

The book retains its primary value as a teaching aid for introductory courses of pharmacognosy as customarily taught in colleges of pharmacy. The inclusion of considerable reference material extends its usefulness to graduate students in the field and to workers in related fields. The writing style is good, and descriptive material is clearly presented. The characteristically excellent morphologic data, valuable in the identification and evaluation of drugs, are well supported by many drawings and photographs.

Claus has instituted timely improvements in the choice of material for inclusion in the text. Discussions of many of the crude drugs of lesser importance have been reduced or deleted, with corresponding emphasis on those more useful to current medical and technologic practice. The chapter on "Allergens and allergenic preparations" has been expanded and reflects well Claus' own experience in teaching this valuable phase of pharmacognosy. The chapter on "Pesticides" has been similarly enlarged in response to the increasing emphasis on pest control and the use of chemical agents for this purpose.

The chapters on "Antibiotics," on "Immunizing biologicals," on "Vitamins and vitamin-containing drugs," and on "Endocrine products" have been rewritten. Discussions of these subjects involve considerable overlapping and some reiteration of subject matter basic to other disciplines in the pharmaceutical curriculum. While I recognize the usefulness of their inclusion in this text, I believe that this value will vary with the treatment given these topics in courses prerequisite or subsequent to the one for which this book is designed. Minor omissions may be noted, as for example the omission of levarterenol bitartrate in the description of the adrenal medulla.

A new heading, "Prescription products," is included for many drugs, as an indication of their inclusion in current pharmaceuticals. The lists given are not complete, and the rapid changes in such categories may lessen the value of these listings in the future. The policy of stating uses and doses continues for many drugs. These follow official descriptions for drugs included in the *Pharmacopeia of the United States of America* or the *National Formulary*. For many, obsolete terms are retained; a review of these in the light of current pharmacologic thinking might well be considered in future revisions.

Appendixes are provided to continue the presentation, in convenient form, of considerable material valuable to the basic study of crude drugs. These include "Powdered drugs" and a "Key to the identification of powders," the "Cultivation of drug plants," and "A taxonomic list of important drugs."

This textbook remains a standard work in the presentation of pharmacognosy. Elements of transition are apparent in the choice and handling of subject matter, yet basic values are retained. I anticipate the continued excellence of future editions of this familiar book in the hands of the current author.

FRANK T. MAHER
Mayo Clinic

An Atlas of Diseases of the Eye. E. S. Perkins and Peter Hansell. Little, Brown, Boston, 1957. 91 pp. Illus. $10.

This most recent and beautifully printed atlas of diseases of the eye covers the commoner external and internal diseases and disorders with superbly colored drawings and photographs and concise text, with the latest information on each subject. It is designed for general physicians and for students, to fill an urgent need. The former will find answers to questions regarding vascular and general systemic disease in which the eye participates. In addition to this, the student may differentiate the trivial from the more important.

The photography is excellent, and the drawings are incomparable. The format is modern, attractive, and very readable. By means of eight-color photolithography, the printer has achieved the best possible results with the illustrations. Roche Products, Ltd., subsidized the work, which, because of this, sells at a fraction of the cost of the printing.

RAYMOND L. PFEIFFER
Institute of Ophthalmology, New York

Textbook of Human Anatomy. J. D. Boyd, Wilfrid E. LeGros Clark, W. J. Hamilton, J. M. Yoffey, Solly Zuckerman, and A. B. Appleton. Macmillan, London, 1957 (order from St. Martin's Press, New York 17). 1022 pp. Illus. $16.50.

The three standard systematic anatomies in current use are tomes in the 1500- to 1700-page range—6 to 7 pounds of book. When they first appeared 55, 64, and 99 years ago, they were much smaller, but they have grown with nearly every edition until each has become a compromise between a reference compilation and a textbook. Cunningham's *Manual* and Grant's *Method*, as topographic rather than systematic approaches, have found a place in anatomic pedagogy, but, except for the now defunct *Piersol*, the "big three" among the systematic books have had no serious competitors for half a century.

This new work is a textbook designed for the beginning student who, because of curriculum changes, often has less time now for anatomy than he did a few years ago. The standard approach is notably abridged, and the resulting book has less than 1000 pages of reading matter. These changes for the benefit of the beginner will, however, give the book less value on the physician's reference shelf.

The six British anatomists who have collaborated are representatives of anatomy departments at the universities of Cambridge, Oxford, Bristol, Birmingham, and London. Hamilton and Yoffey wrote the introduction; Hamilton is author of chapters on the locomotor system (258 pp.) and on the digestive system (98 pp.). Yoffey's chapters deal with the cardiovascular system, including lymphatics (113 pp.), and with the respiratory system (33 pp.) and the spleen (4 pp.). Zuckerman has chapters on the urogenital system (100 pp.), on the ductless glands (34 pp.), and on growth (22 pp.). Clark writes on the central nervous system (129 pp.), and Boyd takes up the peripheral nervous system (143 pp.) and the sense organs, including the skin.

Two things about the plan and organization strike one immediately. First, each chapter contains a fairly large number of orientating remarks, anatomic generalities, and correlations. The authors try to present anatomy as the science of body structure rather than as a listing of topographic relationships. Depending on the topic at hand, these correlations may refer to embryologic or phylogenetic features, to the classification of information, to function, to x-ray appearances, or to aging, growth, and variation. Correlations with microscopic anatomy are more extensive in this book than in other textbooks of gross anatomy. About 15 percent of the book treats of generalities of the sort mentioned.

The second thing to be noted is that the usual detailed descriptive anatomy is markedly abridged. For instance, an artery is described simply as arising in a certain way, proceeding in front of such-and-such a structure, and supplying a certain region by means of ascending and descending branches. Details on the relations of the vessel and on the minor branches and distribution are omitted. Descriptions of individual carpal, metacarpal, and phalangeal bones, and of the minor foot and skull bones, are curtailed or omitted. The facial muscles of expression are named, but only four are described. Anatomists are bound to question the desirability and extent of the cutting that was done in various

places. On the whole, however, the surgery has been skillfully done, and the body that remains is not notably disfigured.

There is no reason why a medical or dental student, with this textbook, a good atlas, and the usual laboratory facilities, could not have a superior course. The textbook, however, will meet with different degrees of enthusiasm from teachers of anatomy. These will assess students' needs differently, and there will be questions about the advisability of this abridgment or that.

Textbook of Human Anatomy, despite the multiple authorship, is simply written; short declarative sentences predominate. Most of the illustrations are colored halftones, and these, on the whole, are diagrammatic, clear, and effective. The paper is heavy and glossy, and the format is attractive. The index seems adequate.

One may reasonably question whether an abridged account of the tracts and finer organization of the central nervous system (even one as effectively handled as Clark's chapter is) should occupy space in a gross anatomy textbook when whole books and special courses are devoted to neuroanatomy. A treatment of meninges, blood supply, external relations, and the ventricular system should suffice.

It is unfortunate, for the American user, that the authors did not delay publication of the edition long enough to permit them to incorporate the Paris revision (1955) of the Basel nomina anatomica terminology instead of the Birmingham revision, which has never been used here.

Several of the illustrations, especially those of the muscles of the back and arm, were reduced too much in size for clarity. The use of a red, or pink, halftone overlay to represent areas of muscle attachment on halftone figures of bones is often not clear. In the section on autonomic nerves, fine yellow lines in the diagrams, indicating nerves, do not show up well, especially under artificial light. The deep blue color added as an overlay to certain figures often obscures more than it clarifies. There are occasional lapses—mislabeling of figures or failures to correlate text and figures—but these are not too bothersome. The geniohyoid muscle was grouped with the scalene muscles! Sometimes, for the smaller muscles, the nerve supply was not mentioned.

No references whatever are listed. Because of the heavy, glossy paper, the book is nearly as big and as heavy as the older textbooks that have 50 percent more pages. The binding does not appear sturdy enough for the weight of the book and for student handling.

The greater part of the information in *Textbook of Human Anatomy* is of the conventional sort. Many provocative references in the British *Journal of Anatomy* and in the American and European literature of the last 25 years or more have been ignored, which could have added a notable flavor of freshness to this book.

W. T. Dempster
University of Michigan

Lehrbuch der Tropenkrankheiten. Ernst G. Nauck. Thieme, Stuttgart, 1956 (order from Intercontinental Medical Book Corp., New York 16). 432 pp. Illus. $15.25.

Until the appearance of this volume, no German-language textbook on tropical diseases had been published since 1942. The present book has a twofold purpose—it is intended for use by students in the Institut für Schiffs- und Tropenkrankheiten, in Hamburg, and for German-speaking practitioners in tropical climates. Ernst Nauck, director of the institute, has, as associates in this undertaking, a large group of distinguished German specialists, yet the chapters have been so closely knit together that they constitute a well-integrated presentation.

The sequence of subjects is somewhat unusual, beginning with arthropods as agents and vectors of disease, followed by parasitic worms, protozoans, spirochetes, bacteria, rickettsias, tropical viruses and fungi, nutritional deficiencies, diseases of various other etiologies, and finally poisonous animals. The last 19 pages provide a comprehensive subject index.

In the beginning of the first section it is stated that tropical medicine, unlike other areas of medical science and practice, requires a fundamental understanding of biology, because of the preponderance of parasitic diseases in warm climates; such knowledge is essential for appreciating the clinical and epidemiologic implications of most tropical diseases. This emphasis is maintained throughout the volume, without sacrificing the practical goal. The material presented under each causative agent includes etiology, geographic distribution, epidemiology, pathogenesis, symptomatology, diagnosis, and clinical management and control. Although the techniques and therapeutic procedures recommended are principally those developed by German workers, important contributions by American and other investigators have not been excluded. Owing, no doubt, to space limitation, sources for most of the information presented have not been cited.

Very few errors or omissions have been noted. On page 48 (first paragraph), "Scott" instead of "Stoll" has been credited with estimation of the amount of global schistosomiasis. In discussing the intestinal amebas (pages 110, 115, 126) the German concept and terminology are followed with respect to *Entamoeba histolytica* as the tissue invader and the morphologically indistinguishable *E. hartmanni* as the lumen parasite. Figure 42 (page 115) suggests that the latter form is a "small race." Chemotherapy for eradication of these two forms is separately but satisfactorily presented. In the color illustrations for thin-film preparations of the human malaria parasites (Figs. 53 to 56) there is an inconsistency in the legends (an apparent oversight) between the designation for male and female mother sex cells—*Mikrogametozyt* and *Makrogamet*. In Table 20 (page 405) the term *solenoglyphae* is not provided for viperine snakes, as distinguished from the categories *aglyphae, opisthoglyphae,* and *proteroglyphae*; instead, the family name *Viperidae* is employed.

The text is unusually lucid; the illustrations are excellent, well chosen, and beautifully reproduced; the format is pleasing; and the binding is attractive. This book should not only serve its intended purpose for German students and practitioners of tropical medicine but, because of its concise, authoritative, up-to-date information, is recommended to readers who commonly consult English reference books.

Ernest Carroll Faust
Universidad del Valle, Colombia

Pica. A survey of the historical literature as well as reports from the fields of veterinary medicine and anthropology, the present study of pica in young children, and a discussion of its pediatric and psychological implications. Marcia Cooper. Thomas, Springfield, 1957. 114 pp. $3.75.

This is an interesting and well-organized account of pica (a Latin word, meaning "magpie," that refers, in this connection, to the eating of clay, plaster, ashes, and charcoal), which has been observed in many peoples in all parts of the world, from ancient times. The historical summary is particularly well done, as is a survey of the current incidence of pica. This may be greater than suspected. It occurs in groups suffering from dietary deficiencies and in people on whom heavy nutritional demands are made, such as young children and childbearing women.

Laboratory studies on domestic and experimental animals show that animals seek, from dirt or other materials, that which may compensate for dietary defi-

ciencies, especially for lack of iron or phosphate. The book gives a careful review of self-regulating dietary functions as studied in laboratory animals and young children.

The current study deals with 784 children in the Baltimore area, of whom 172, or 22 percent, had a record of pica. The incidence of pica was 27 percent in Negro children and about 17 percent in white children. This was correlated with the incidence of nutritional problems and the percentage of illness and physical defect.

The hypothesis that poor nutrition may be the underlying factor in pica is well documented historically, especially in connection with the Negro slaves in the South, and by experimental and clinical studies. The volume is well arranged, and there is a good index.

CHAUNCEY D. LEAKE
College of Medicine,
Ohio State University

History and Philosophy of Science

Edward Palmer, Plant Explorer of the American West. Rogers McVaugh. University of Oklahoma Press, Norman, 1956. 430 pp. Illus. + plates. $6.

Edward Palmer was one of the great pioneer collectors of a century ago, principally in the Southwest and in Mexico. As an outstanding collector, he was proficient in many fields, "gathering for the museums of the world more than 100,000 specimens of plants and uncounted thousands of archaeological, ethnological, and zoological specimens," corals, amphibians, marine animals, birds, insects, land shells, reptiles, sponges, mammals. A self-trained man, he was given to writing vivid field notes but leaving to his scientifically trained colleagues the responsibility of seeing that the notes got incorporated with the specimens. Human nature being what it is, this seldom happened, and the museums and herbaria of the world contain tens of thousands of Palmer specimens accompanied by only the most fragmentary information.

Nearly 20 years ago, Rogers McVaugh stumbled on an almost complete set of Palmer's field notes, together with many other manuscripts related to his life and travels. The present volume is the result of a devoted winnowing of these materials and of many others, painstakingly assembled from various institutions and individuals. It is essentially a gazetteer of Palmer's travels and collections, written very largely with the needs of present-day taxonomists in mind. Some 229 pages are devoted to a meticulous account, in alphabetical order, of all the localities in which Palmer is known, or supposed, to have done his collecting. As one turns the pages and reads an item here and there, one does not know whether to be more astounded at Palmer's persistence in getting around the world on slender means, at a time when traveling conditions were very primitive, or at McVaugh's persistence in running down and assembling exact information —from ancient and modern maps, from letters, from his own travels, from records in the government files, and from specimens in the herbaria of the world. Take this entry, for instance (and remember there are more than 200 pages of such concentrated, codified, corrected information about the doings of 50 to 100 years ago):

"Otinapa, Durango, 24°11′N, 105°W. *1906. July 25–August 5.* on August 7 Palmer wrote from the city of Durango: 'I have today returned to this city from the Hascienda [*sic*] of Otonapa 35 miles n.w. of Durango City . . . at which place spent 12 days.' Nos. 332–465, 546–55, 559, and 560 were collected. The distance from Durango is not far from 35 km. (not 35 miles as stated by Palmer, nor 65 miles as given in the set of the field notes at the Gray Herbarium). The Hacienda of Otinapa is now (1951) nearly abandoned, but it is accessible by a poor road from Otinapa station on the railroad. The site of the old hacienda, about 20 km. north of the railroad, is in a broad cultivated stream bottom, with grasslands and pine forests on the hills above it and some rough broken land in the canyons along the creek."

Preceding this section there is a chronological account of Palmer's life, with particular reference to what he collected, where he collected it, and under what conditions. Following it are five appendixes: a chronology of his plant collections and locations of known sets of field notes; a list of herbaria known to have significant numbers of his plant specimens; his botanical field notes from the Colorado trip of 1861 and the Indian Territory collecting of 1868; and his last will and testament. There is a meticulous list of original source materials and a short and very incomplete index.

But for two things it would be all this and nothing more—a useful technical compendium of the goings and comings of Edward Palmer and the herbarium specimens which resulted therefrom. The first of these things is McVaugh's skill, not only as a finicky and indefatigable cataloger, but as a writer of good, plain, easy-to-read English prose. The other is the man Palmer, himself. The fullness of his own record, now that McVaugh has pointed the way to it, makes it a gold mine of social history. And, in this book, we see the character of the man—able, so taciturn about many things that we have only a sketchy notion of his life in spite of his voluminous record, cross-grained in some relationships yet singularly sweet at times (so that an old Mormon lady now sits down and writes a charmingly detailed account of how he set all the pioneer children in one home to collecting insects).

Of all plant labels, Palmer's are certainly the ones most worth saving. He may not have known how to spell or to punctuate, but he had a remarkable eye for essentials and a gift for pithy phrases. They are more than just scientifically accurate; they are the raw material of poetry. Here are some examples, with the original spelling and punctuation:

"309 edges of woods and parias yellow as soon as the sun is hot the petals curl under June 26 boiling spring Chickasaw nation."

"198 Pigg weed old road sides old fields and wood openings all over the country May 28."

"430 white mottled purple sage cented a decotion is made of this plant and used in feavers it is also used to wash the skin to cool it June 26 moist spots in wood and by raveins boiling spring to Rileys Mill."

"477. fox grape on gravelly wooded hills and raveins often but very short wood pendant to ground and unsupported by trees of a very agreeable foxy taste pulp thick rather tough makes fine preserves . . ."

Palmer's personality obviously fascinated McVaugh, who goes out of his way to describe Palmer's unsuccessful attempts to bottle *pulque* and *aguamiel* commercially, and to comment grimly on his calmly collecting ethnological material in an Apache village immediately after it had been wiped out in a punitive expedition. He was, says McVaugh, "a man who could neither express himself clearly nor spell his words consistently, but who corresponded regularly on an equal basis with the leading scientists of his day. He performed prodigious feats in accumulating, packing, and safeguarding collections of all kinds of fragile materials and he prepared copious data sheets to accompany the specimens, yet he rarely succeeded in keeping his records free from errors and hardly ever managed to distribute his specimens with the data he provided. He was small and frail and passed hardly a year without some incapacitating accident or illness, but when he was seventy-five years old he was still able to take in stride a week's trip on horse back in the rough mountains of western Durango. . . . The impulse that took him back to the field again and again must have been not a liking for collecting itself but little more than a liking for travel and for strange places, a feeling that by his work he was contributing to science, and a willingness to accept commissions to collect certain classes of materials in return for the opportunity to go out again."

The book is attractively printed and put together. It is ingeniously arranged for ease of consultation by taxonomists. The ethnologist, the social historian, the general student of the Southwest will find the index maddeningly inadequate. *Aguamiel,* for instance, does not appear at all in the index, and the reference to cactus candy is hidden (to all but the initiated) under *Opuntia.* However, the book is such a rich mine of all kinds of information that a first-class index would have been just one more major project.

EDGAR ANDERSON
Missouri Botanical Garden

Philosophy of Science. Gustav Bergmann. University of Wisconsin Press, Madison, 1957. 181 pp. $4.75.

Originally planned as the foundation section of a volume on the philosophy of psychology, *Philosophy of Science* focuses on those ideas considered by the author to be indispensable for logical analysis of the behavioral sciences. Despite this orientation, the book will be of interest to philosophers generally and to philosophically minded scientists in other domains, for, aside from analyses of physical concepts by way of paradigm, Gustav Bergmann provides an introduction to notions such as "deduction," "existence," "definition," and "number"; recurrent remarks on philosophic analysis by means of schematic representation in "improved" languages; and a general discussion of description and explanation in science.

Of special significance in connection with the latter topics is the author's fruitful characterization of types of scientific law, including what are called "process," "cross-sectional," "equilibrium," "developmental," "statistical," "historical," and "composition" laws. The subject of composition laws introduces Bergmann's illuminating analyses of a whole cluster of problems, which have figured importantly in psychology and the social sciences, concerning *Gestalt,* holism, emergence, and reduction. Not the least valuable feature of these analyses is the pinpointing of ambiguities in key terms such as *whole* and *additive*—ambiguities crucial to their philosophic use by some writers.

Rather disconcerting is Bergmann's omission of adequate citation to related literature, and even more so are his occasional controversial comments on authors whose views are neither quoted nor specifically cited, notably John Dewey. But most disturbing to me are the flat judgments thrown out offhandedly on difficult issues. Thus, to take two examples, we are told (page 40) that "the ideal language, by the way, is 'phenomenalistic' " and (page 87) that, while there has been "a good deal of talk, in the nether regions of the intellectual universe" to the effect that recent physics has given up Newtonian mechanism and determinism, "it is worth mentioning . . . that these views are also thoroughly mistaken." This last is doubly disturbing when we learn (page 124) that quantum phenomena "form an area of relative chance," and that our idea of the physical universe, though deterministic, is not mechanistic, as Newton's was, in one sense clearly specified in the text.

Bergmann's logical framework is not nearly so subtle as some of his analyses of physical and psychological issues. Readers will find it impossible to tell, from his treatment alone, how controversial his logical-descriptive and analytic-synthetic dichotomies have become in recent discussions. Nor does Bergmann, in the face of a history of critical treatments, qualify his pronouncement of the existence of simple and complex properties and relations named by descriptive words—an affirmation which, incidentally, seems to conflict with the extensionality he appears to espouse (page 55). And, in place of various philosophic methods suitable for a variety of purposes, he frankly searches for an "ideal language" in which *everything* can be stated and *all* philosophic problems can be analyzed. Despite these strictures on his general framework, it must be said that his specific analyses of explanation, law, and holism stand pretty much on their own feet and are, moreover, enlightening and suggestive. It is to be hoped that they will be widely and seriously studied.

ISRAEL SCHEFFLER
Harvard University

A History of Technology. vol. II. *The Mediterranean Civilizations and the Middle Ages.* Charles Singer *et al.* Clarendon Press, Oxford, 1957. 802 pp. Illus. $26.90.

It is with great pleasure that we receive this, the second of five projected volumes of essays on the history of technology, all written by experts and admirably edited by competent historians. As the world speeds on at an ever more dizzying pace toward apparent total reliance on technologic man, interest inevitably grows in answers to the question: How has it all come about? Whence has come our technocentric predicament? It is obvious that we are here, but how and why? It is curiously significant that historians are at last seriously taking stock of certain anachronistic elements within their own pursuit. Social and economic history has always sought a prop—if oftentimes a shaky one—in the material factors of history. But even today there is, as yet, no fully professional discipline which can be called "history of technology." When one realizes that, except for sporadic scholarly adventures in narrow byways (as well as misadventures on the textbook level), no competent history of technology has existed in the English language, is it not clear that the present monumental effort is epoch-making? In this sense, the present undertaking appears to be a sort of belated historian's anabasis into the obvious. Let us hope that it will spur on still others, especially here in America, to develop the history of technology with a degree of energy comparable to that now expended on other historical disciplines.

Volume I of *A History of Technology* [*Science* **121**, 549 (1955)] related a history of the period from earliest antiquity through the fall of the pre-Greek "Ancient Empires." This history, of necessity, relied almost exclusively on evidence unearthed by archeologic excavation. This of course is the result, in part, of the fact that many pre-Greek literatures are lost and hence unknown to us. In addition, perhaps because of the randomness of archeologic finds, what fragments we do possess from such literatures are mainly nontechnical. Hence, artifacts provide the soundest clues about the nature and sources of the substances employed in pre-Greek technology, and tools, especially, point to the techniques themselves.

The present volume deals with classical and postclassical civilizations of the Mediterranean and of areas to the north, through approximately 22 centuries. Although archeology remains vital for an understanding of this period, literary evidence constantly increases until, by the end of the 15th century, the historian's problem is decidedly one of selecting representative documents from a vast array of possibilities. The editors carefully point out that the problem of selection will become increasingly acute as the project moves nearer to our own times. The tempo must increase. If volume I registers *andante,* then volume II is a movement in *andantino.* Inevitably, succeeding volumes will reach *allegretto* and *allegro.*

It is impossible, in such a brief review, to do more than outline the contents of 800 pages of detailed history. The general plan of volume I has been only slightly modified in volume II. After a brief but useful set of "Historical notes," by A. R. Hall, there are five basic subdivisions, which divide the concept of technology as logically as it can be done.

Part 1 concerns "Primary production," by which is implied the production of the most basic raw materials. The late C. N. Bromehead contributed an analysis and description of "Mining and quarrying to the seventeenth century." This is followed by an excellent history of "Metallurgy," by R. J. Forbes, undoubtedly the leading expert in this field and period. Finally, E. M. Jope has written on "Agricultural implements," which, as part of the broader history of agriculture, complements other chapters in both volumes I and II.

Part 2 treats of "Manufacture." Forbes has contributed a chapter on "Food and drink." John W. Waterer writes on "Leather," to which is appended "A note on parchment," by H. Saxl. "Spinning and weaving" is treated by R. Patterson. Description of the manufacture of furniture and ceramics is subdivided by periods: Cyril Aldred writes on "Furniture: to the end of the Roman Empire," and R. W. Symonds discusses "Furniture: post-Roman." Gisela M. A. Richter analyzes ceramics in the earlier period, and Jope contributes the articles on medieval ceramics. "Glass and glazes" are described by D. B. Harden. The late F. Sherwood Taylor, well known historian of science, and Charles Singer have written an extremely valuable history of "Prescientific industrial chemistry," in which they complete the account of what is known of both high- and low-temperature processes and cover phases not specifically treated in other chapters. To this chapter is appended "A note on military pyrotechnics," by Hall, which I found awesome and intriguing. In addition to such well known combustible products as naptha, bitumen, resins, and later, gunpowder, Hall discusses the infamous, secret "Greek fire" in detail. It was undoubtedly because of the use of "Greek fire" that the Byzantine Empire, for example, successfully withstood the Muslim attacks of the 7th century and later.

Part 3 concerns "Material civilization," and includes "The medieval artisan," by R. H. G. Thompson, "Building construction," by Martin S. Briggs, and "Fine metal-work," by Herbert Maryon. To the latter is added "A note on stamping of coins and other objects," by Philip Grierson.

In part 4, devoted to "Transport," R. G. Goodchild and Forbes discuss "Roads and land travel, with a section on harbours, docks, and lighthouses" in masterly fashion. All that is known to date concerning, for example, the famous Roman roads and the lighthouse at Alexandria—one of the wonders of the ancient world—is beautifully summarized, with a detailed bibliography which will lead the interested reader to scholarly literature dealing with special problems. In this same section, "Vehicles and harness" are described by Jope, and "Shipbuilding" is described by T. C. Lethbridge.

The final part 5 deals with "Practical mechanics and chemistry." Forbes again contributes a chapter, on "Power," and there is an appended "Note on windmills," by Rex Wailes. It may surprise some readers to find that the earliest authentic mention of a windmill in the Western world dates from no earlier than circa 1180. This is followed by an excellent chapter on "Machines," by Bertrand Gille. To this is added "A note on ancient cranes," by the famous historian of technology, A. G. Drachmann. It is followed by three chapters: "Hydraulic engineering and sanitation," by Forbes; "Military technology," by Hall, and "Alchemical equipment," by E. J. Holmyard.

After all these solid contributions, to which I cannot do justice here, we find an "Epilogue: East and West in retrospect," by Charles Singer. Since, from the earliest planning stages, the editors understandably found it impossible to bring, within the compass of five volumes, a history of *world* technology that would be both responsible and comprehensive, the decision was forced on them to restrict their history almost exclusively to what we know as Western civilization. Yet they are well aware of the fact that the West did not live in technologic isolation. Indeed, Singer finds that, during the span of the last millennium covered in the present volume, "technologically, the west had little to bring to the east. The technological movement was in the other direction. Not seldom, and especially under stress of persecution and war, there were emigrations of eastern craftsmen to the west. These taught their methods to European pupils and apprentices, and so added the technical traditions of their own lands to those already being practiced in Latin Christendom. . . . Thus from Persia and China, and to some extent from India, materials, wares, techniques, and ideas filtered through the main approaches to the west" (pp. 757–758).

The epilogue is therefore designed to suggest adjustments in our historical perspective, and the design is admirably carried out. If one studies carefully only two pages (770–771), which consist of a chart that shows the "Transmission of certain techniques from China to the West," one cannot help but realize the magnitude of our often forgotten technologic debt to the Far East.

The only misprints I have noted are few and innocuous, an indication of the great care and accuracy everywhere visible in this work. They do not even bear listing here, for if the reader finds them he will correct them more easily himself. The book is well printed, and the plates are excellently reproduced, as is usual with books from the Oxford press. There are some 700 figures in the text, all clear and well detailed. Three indexes, of personal names, place names, and subjects, make the volume as a whole easy to consult. In addition, each article is followed by a list of exact references and usually by a separate general bibliography which covers that particular topic. Finally, it might be mentioned that volume II has been considerably lightened, in comparison with volume I, by the sensible use of thinner, yet amply strong, paper within the same format. This is still far from a pocket book, and for this we are also glad, but it is at least easier to handle than is its somewhat bulky predecessor.

WILLIAM D. STAHLMAN
Massachusetts Institute of Technology

History of Analytic Geometry. Carl B. Boyer. Scripta Mathematica, Yeshiva University, New York, 1956. 291 pp. Illus. $6.

The greater part of the *History of Analytic Geometry* was first published as a series of articles in *Scripta Mathematica,* volumes 16 through 21 (1950–55). It is gratifying that the complete book, in final form, has now appeared.

The first four chapters cover the period prior to the beginning of the 17th century and give the history of the ideas which precede the invention of analytic geometry proper. Although coordinates in the plane or on the sphere were already used in ancient times, in particular by Greek mathematicians in connection with their very elaborate theory of conic sections (founded by Menaechmus and systematically completed by Apollonius) or with their astronomy, the Greek mathematicians did not develop an algebraic geometry in our sense. Probably one of the chief reasons is the fact that their algebra had a geometric form. The introduction of a literal symbolism into algebra during the 16th century—in particular the work of the French mathematician Viète—was an important preparation for analytic geometry.

The central chapter V of the present book is devoted to the two great French mathematicians Fermat and Descartes, who, in the first part of the 17th century, almost simultaneously, but independently, founded analytic geometry. Although Descartes' book *La Géométrie* was published in 1637, Fermat's short but systematic treatise *Ad Locos Planos et Solidos Isagoge* and his other contri-

butions to analytic geometry were not printed during his lifetime; hence, it is difficult to estimate their influence. There was an essential difference of emphasis between the works of Fermat and Descartes: Descartes usually started with a locus problem and then obtained an equation of the locus; Fermat, conversely, had the habit of beginning with an equation from which he derived the properties of the curve.

Chapters VI ("The age of commentaries"), VII ("From Newton to Euler"), and VIII ("The definitive formulation," which leads into the second part of the 18th century), show how slow, relatively, the further progress in analytic geometry was: it was some time before negative abscissas were admitted, before two axes in the plane were systematically used, or before solid analytic geometry was developed. The author calls Euler's *Introductio in Analysin Infinitorum* (1748) the most influential textbook in modern times and, in particular, considers this work a turning point in the development of analytic geometry.

Finally, chapter IX, "The Golden Age," is devoted to the great and original advance in the first three-quarters of the 19th century. The remarkable contributions of the German mathematicians Möbius and Plücker and of the English mathematician Cayley, among others, are stressed: barycentric and homogeneous coordinates, symbolic notations, line coordinates and line geometry, the theory of algebraic curves, and the more dimensional analytic geometry. The last quarter of the 19th century and our 20th century are not taken into consideration by the author.

ARTHUR ROSENTHAL
Purdue University

Physical Sciences

Pion Physics. vol. 2 of *CERN Symposium on High Energy Accelerators and Pion Physics, Proceedings.* European Organization for Nuclear Research, Geneva, 1956. 444 pp. Illus. F. 40.

This is the second volume of the papers submitted to the European Organization for Nuclear Research (CERN) Conference, held at Geneva 11–23 June 1956. After the meeting, the proofs were checked by the editors against corrected preprints. In general, the speakers who took part in the discussions also had an opportunity to correct the text of their remarks.

There is a group of eight papers on bubble chambers, including a review of the field by Brown, Dodd, Glaser, and Perl (University of Michigan) and Rahm (Brookhaven), followed by a series of discussions of experimental work at the University of California, the University of Chicago, Duke University, the U.S.S.R. Academy of Sciences, the University of Padova, the University of Pisa, and the Centre d'Etudes Nucleaires. The fact that bubble chambers are far from having taken over the fundamental particle experimental field from cloud chambers is shown by a series of five papers on more standard chambers, from sources almost equally well distributed geographically.

A group of nine papers on fast counting techniques, most of which are related to Cerenkov counters, includes one paper on neutron time of flight techniques in the 100 Mev region, by Stafford (Harwell). Two papers are included on antiproton physics, including reviews, by Segrè, of the Berkeley work and, by Amaldi, of cosmic-ray work. Papers on nucleon-nucleon scattering are presented, primarily from the U.S.S.R.

A group of papers on the theory of pion physics includes a review by Wick, an article on the generation of mesons in nucleon collisions by Blokhintsev, a discussion of radiation during the collision of pions and nuclei by Landau and Pomeranchuk, and a simple treatment of meson-nucleon scattering, using the Yukawa potential and the Born approximation, by Edwards and Matthews. Wick's review nicely points out that "features of meson theory included in the cut-off model have something to do with reality."

A paper by Kallén discusses the mathematical consistency of quantum electrodynamics. Kallén carefully points out that his ideas do not constitute mathematical proof but are intended to serve as a basis for further discussion.

Papers on pion nucleon scattering include a review by Yuan (Brookhaven); data at six energies from 200 to 300 Mev from the U.S.S.R.; data at 150, 170, and 220 Mev by Ashkin, Blaser, Feiner, and Stern (Carnegie Institute of Technology); data at 70 and 130 Mev by a group from Bologna; a discussion of phase shifts by Orear, at Columbia University; and two papers on the very low energies of 20 Mev and 18.7 Mev, respectively, from Liverpool and Chicago.

On the subject of photoproduction of pions there is a review by Bernardini (Illinois) and there are about ten papers, including photoproduction from bound nucleons and complex nuclei as well as from protons and deuterons. This section of the conference includes an announcement, by Pauli, of the telegram received, 15 June, from Reines and Cowan at Los Alamos, stating the detection of neutrinos in the inverse beta decay of protons.

A section on pion production by nucleons includes an introductory talk by Merrison (Liverpool) and a group of papers, including bombarding energies from 383 Mev at Liverpool, 600, 650, and 929 Mev at Birmingham, 660 Mev in the U.S.S.R., and various energies up to 2.75 Bev at Brookhaven.

A few papers on mesonic atoms were introduced, with a review by Roberts (Rochester). These include the beautiful proportional counter work of West and Bradley at Harwell, the absolute yields by the two Stearns at Carnegie Institute of Technology, and the work on the lifetime of muons by Lederman and Weinrich at Columbia.

This volume provides a useful review of the state of the art, both theoretical and experimental, in pion physics as of the time of the meeting. The authors and editors have done an excellent job in presenting up-to-date, accurate material in a form very useful for reference. The drawings of experimental equipment and the curves presented are remarkably clear and accurate for a publication of this nature.

E. CREUTZ
General Atomic,
General Dynamics Corporation

Handbuch der Physik. vol. XXI, *Gas Discharges I*; vol. XXII, *Gas Discharges II.* S. Flügge, Ed. Springer, Berlin, 1956. 683 pp.; 652 pp. Illus. DM. 105.50; DM. 128.

At certain epochs of advance in the field of physics, there have appeared in Germany notable *Handbucher*—or, better, encyclopedias—of physics. I gratefully recall Winckleman's *Handbuch,* which was so useful to me in my student days. Nearly coincident with the development of the modern outlook on physics —ushered in by the age of atomic structure and quantum mechanics in 1926—there appeared a truly monumental and invaluable work in 26 volumes, the famous Geiger and Scheel *Handbuch der Physik,* from the presses of Springer. Now, 30 years later, following the post-World War II advances, there appears, under the editorship of S. Flügge, the timely new *Encyclopedia of Physics* of international scope, from the same publishing house. Volumes XXI and XXII comprise summaries of most of the material in the fields of electronics and gaseous electronics. The increasing demands of an adequate modern knowledge of these fields, so vital to technologic and experimental advance, make the publication of these two volumes, by many authors, an invaluable addition to the modern literature, since the scope of recent advances makes it impossible for any one person to summarize expertly this material.

Flügge is to be congratulated on having secured contributions from a group of authors so competent in their respective

fields. These, written in the author's native language, have been admirably edited, printed, and bound. Although most of the articles in these two volumes are in English, the absence of serious typographic errors is remarkable. The prodigious labor and encyclopedic knowledge required of the editor in such a task indicate that future publishers and editors of encyclopedias of this nature should designate a senior subeditor of broad training and experience to be responsible for the volumes in a general field of interest, to edit and supervise the contributions to these volumes, and to insure an adequate and balanced coverage of the various fields by the specialist authors.

Volume XXI deals largely with basic processes of electronics and gaseous electronics, while volume XXII integrates these in relation to various breakdown mechanisms. Volume XXI is divided into nine chapters.

Chapter 1, "Thermionic emission," is written, in English, by one of the world's leading experts, Wayne B. Nottingham. Needless to say, it is comprehensive and well done, although one might wish that less time had been spent in trying to justify the author's theory of reflection at the interface, which, in the light of the recent work of H. Shelton, appears to be disproved.

Chapter 2, "Field emission," is written jointly by R. H. Good, Jr., and Erwin W. Muller. The theoretical aspects are presented by Good in an exceptionally clear and able fashion. Concerning the experimental contributions of the world's leading expert in this field, it is unnecessary to comment except to state that the article presents a good summary of all the recent contributions to the problem, including Muller's own remarkable work on positive-ion field emission and surface microscopy, using field ionization of inert gas atoms and making visible, for the first time, single-surface atoms.

Chapter 3, by Rudolph Kollath, in German, summarizes the present status of knowledge of secondary electron emission on electron bombardment—so essential to modern technology—in the comprehensive and excellent fashion to be expected from one of the world's leaders in this field.

Chapter 4, by Gerhard L. Weissler, in English, succeeds remarkably well in compressing into 60 pages the extensive work, theory, and experimental data on photoelectric ionization in gases and on photoelectric emission from solids to which he and his group have made prominent contributions. This recent compilation of data is indispensable for the interpretation of many currently studied breakdown phenomena.

Chapter 5, in English, represents the first attempt at a unified summary and presentation of the rapidly developing, generalized kinetic theory concerning the motion of electrons and ions in gases. It was written by W. P. Allis, who is currently the world's leading expert in this field. Since this material has, in the past, been widely dispersed among authors and journals, and chronologically, in the literature, this concise, carefully coordinated, systematic presentation in terms of a consistent symbolism is of inestimable value as a background from which to follow the progress of the coming era of highly and otherwise ionized gases. It is, however, in connection with this article that lack of properly oriented editorship is to be noted, for there is omitted from this volume all mention of experimental techniques and data on drift velocities and energies, elasticities of impact, and mean free paths of the electrons in fields in gases. Likewise, all discussion of the experimental techniques, values, and data on ionic drift velocities in gases is lacking, as are the questions of ionic nature, complex molecule formation, clustering, and charge exchange, about which much is known today that should be made available.

Chapter 6, by L. B. Loeb, in English, deals with the formation and nature of negative ions in gases, including methods of study, energies of formation, experimental results, and interpretation. Some data on the appearance of negative ions from other sources in gases are included.

Chapter 7, by Loeb, considers the complicated variants of the analytically simple-appearing processes manifested under the general designation of recombination of ions. It presents experimental methods, their limitations, existing theory, and interpretation of existing data, including the anomalous values of the electron-ion coefficients around 10^{-10} observed in certain glows and arcs.

Chapter 8, by A. v. Engel, in English, deals with ionization by electrons in electric fields. Engel has written various articles in this field and is a veteran investigator, but this chapter, while perhaps adequate in coverage, is somewhat primitive and perhaps ill-advised in its handling of antiquated theory. It omits proper emphasis on the important, newer secondary ionization processes, such as the Hornbeck-Molnar process, the statistical fluctuations in the coefficient, and processes violating the similarity principle in which a/p is a function of distance of advance x and pressure p, as well as of E/p, and may show temporal lags and diffusion.

Chapter 9, in English, by P. F. Little (who is a relatively young newcomer to the field), is a thoroughly workmanlike and exceptionally complete presentation of the rapidly growing and complex field of secondary processes in gaseous breakdown. He presents the physical processes in the Townsend discharge, the measurements made by means of steady discharges, the time-dependent studies of secondary mechanisms, measurements in nonuniform fields, and the relative importance of the mechanisms. Next he presents the mechanisms active in other discharges, such as in glows and arcs. The last section deals with direct measurements, such as those of emission by positive-ion bombardment, including Hagstrum's recent work and other processes.

All told, this volume, with the exceptions noted, presents a very complete coverage of the subject and is indispensable to the physicist engaged in this field as well as to many others who will find it useful as a reference book.

Volume XXII of the series is divided into seven chapters.

Chapter 1, "Ionization growth and breakdown," by F. Llewellyn Jones, in English, presents the concept of the electric breakdown of gases—in contrast to that of breakdown and spark discharge—as an extension of the work of the original Townsend school, in which the author participated. The article is devoted in large measure to a presentation of the extensive investigations of the author's group (reports of which are scattered widely through the literature) in which, using adequate pre-World War II techniques but failing to use the modern Alpert vacuum and fast-time resolutions observational techniques, they rediscover and establish in new fashion the secondary cathode mechanisms earlier reported by many workers outside the Townsend school. Aside from presenting these findings in a coordinated and collected form, the article is valuable, since it includes the very excellent theoretical analyses of P. M. Davidson for temporal growth of ionization in uniform fields, which are the best to date, and which were carried out in collaboration with this group.

Chapter 2, "The glow discharge at low pressure," by Gordon Francis, in English, is a complete and remarkably clean-cut critical evaluation and survey of the phenomena associated with the glow discharge by a relatively young investigator in the field. The literature coverage of old and new work is exceptionally full, and excellent judgment is shown in the choice of material presented. I know of no other recent article in this field that can furnish the reader with as useful and comprehensive a survey of this subject, on which probably more extensive research has been done than on any of the other topics.

Chapter 3, "Radiation from low pressure discharges," by Richard G. Fowler, in English, probably should have appeared in volume XXI, for it is properly an article on basic processes. However, it would be welcome wherever it might appear. Written by one of the younger but leading workers in the field, this

analysis and presentation of the basic atomic theory of general aspects of gas radiance, excitation, and depopulating processes, covering both theory and experiment, is exceptionally lucid, up to date, and, in fact, superb. It adds practical value and usefulness to the subject content of both volumes under review.

Chapter 4, "Electrical arcs and thermal plasmas," by W. Finkelnburg and H. Maecker, in German, constitutes the *pièce de résistance* of this volume. It alone makes the purchase of this book imperative for the modern worker in gaseous electronics. In 1950, before publication of volume XXII, I asked Finkelnburg to write a chapter on arcs for a contemplated and still only partially completed book on the electric breakdown of gases. He replied that he felt not enough was known about arcs for him to write such a chapter. After joining the group at the Sieman's Laboratory in Erlangen, Finkelnburg and Maecker, with their able coworkers, cracked the mystifying cipher of the electric arc behavior. As a result of their modern and versatile experimental techniques and modern and sound, but often laborious, theoretical physical analyses, they are able to present, in this chapter, the most advanced and complete description yet given of that group of phenomena classified as arcs—a description which is physically sound and satisfying. Thanks to their activities, these phenomena are now perhaps the best understood of all the breakdown forms. Much work yet remains to be done, but with my past experience, I stand in awe of this achievement. For all those venturing into high temperature plasma work, a careful study of this chapter is imperative.

Chapter 5, "Electrical breakdown of gases with steady or direct current impulse potentials," by Loeb, starts with basic definitions of electric breakdown and spark breakdown in terms of current potential relations. Next, the temporal growth of the Townsend discharge is developed. This leads to the threshold equation and its implications. Then follows a treatment of statistical fluctuations in terms of theory and experiment, which leads to concepts of time lags. Breakdown in nonuniform fields at highly stressed anodes is discussed in terms of photoionization in gases, leading to the Geiger counter pulse and the streamer mechanism. Spark breakdown, through streamers, is related to the Townsend thresholds through time-lag studies of Fisher and Bandel. This is followed by an analysis of steady breakdown to Townsend discharge in coaxial cylindrical and point-to-plane gaps for various gas types, both from highly stressed anodes and cathodes.

Chapter 6, by Sanborn C. Brown, in English, deals with the breakdown in gases in alternating and high-frequency fields. In his characteristic clear and concise style, this leading experimental investigator develops the basic concepts in an admirable fashion. The more esoteric theory based on the Boltzmann transport equation is then developed, and about it as a framework is developed the theory upon which interpretation and computed comparison with experiment is made. The work of the author's school is effectively collected and summarized in terms of solutions for various container forms with superimposed direct-current and magnetic fields. Further discussion covers electron attachment, controlled breakdown, and mobility controlled breakdown and introduces the amplitude oscillation limit concepts. The secondary electron resonance controlled breakdown is also treated. A notable omission is the lack of any discussion of the alternating-current breakdown for the low-frequency cases with external electrodes or internal electrodes, at frequencies much below 10^5 cycles—a field of current interest which merits the critical techniques and analyses of this excellent group of investigators.

Chapter 7, "The lightning discharge," by B. F. J. Schonland, in English, is a remarkably fine summary of this complicated phenomenon by the world's leading expert. It is beautifully written and (unlike his more popular booklet, *Flight of the Thunderbolts*) is a highly valuable, scientific, professional treatise on methods, results, and interpretation (as of 1956), and encompasses all important contributions, including his own.

In summarizing the contents of this volume, I can only say that the appearance of volume XXII has rendered unnecessary the completion of my own half-written volume on electric breakdown of gases and represents an essential addition to the library of all workers in the field.

LEONARD B. LOEB
University of California, Berkeley

Solid State Physics. Advances in research and application. vol. III. Frederick Seitz and David Turnbull, Eds. Academic Press, New York, 1956. 588 pp. Illus. $12.

This latest volume of comprehensive survey articles on various aspects of solid-state physics contains six articles. The first, by Welker and Weiss, is an almost encyclopedic account of present knowledge about III–V compounds. Extensive references are given to methods of preparation and to physical properties. The main body of the article discusses the electric, magnetic, and optical properties of both pure and doped materials.

The second article, by Eshelby, discusses the continuum theory of lattice defects. This theory is applicable to the study of the deformation and energy changes associated with the presence of defects. The formal theory is given in some detail, and applications to point defects and dislocations are discussed.

The third article, by Guttman, is on order-disorder phenomena in metal alloys. After a short but useful introduction to the subject, the author discusses the various types of short- and long-range order and their description. There are sections on thermodynamic and statistical treatments of the problem and on the kinetics of order-disorder transformations. Many references are given.

The primary purpose of David Turnbull's article on phase changes is to discuss the problem of the formation of one phase of a given substance in another phase of the same substance. The article gives ample references to the field and includes a review of the thermodynamics of phase changes, a discussion of phase stability, and the theory for phase-change kinetics. Nucleation and precipitation are discussed in detail.

In the article on imperfections in crystalline solids, Kroger and Vink consider vacant lattice sites, interstitial atoms, misplaced lattice atoms, foreign atoms, and electrons and holes. The main purpose of the article is to discuss the interdependence among the concentrations of the various types of imperfections, but, in so doing, it covers nearly the entire field of imperfection studies. More than 400 references are given.

The final paper, by Kittel and Galt, is on ferromagnetic domain theory. This is an excellent review of domain theory and its application to the understanding of the behavior of ferromagnetic materials. Many useful references are given.

The diverse subject matter of the review articles in this volume is probably unavoidable. With the present increase in specialization, the survey volume is becoming indispensable, and it is pleasing to see that the high standards for clarity of the first two volumes in this series are being maintained.

A. F. KIP
University of California, Berkeley

The Encyclopedia of Chemistry. George L. Clark, Ed. Reinhold, New York; Chapman & Hall, London, 1957. 1037 pp. Illus. $19.50.

This encyclopedia provides a thorough and timely coverage of at least 1000 chemical and physical terms, selected mainly, though not exclusively, on the basis of their importance to industrial chemistry. In addition, the work con-

tains useful biographic data and descriptions of professional societies and governmental and private research organizations.

The contributors are men of real stature in their fields, and their contributions are interestingly and authoritatively written, without presupposition of much chemical knowledge on the part of the reader.

The work will be most useful to those of limited technical background who are faced with locating an item of chemical information in its proper context or with developing an understanding of the nature and importance of an industrial process.

Advances in Chemical Engineering. Thomas B. Drew and John W. Hoopes, Jr. Academic Press, New York, 1956. 448 pp. Illus. $10.

This book is volume I of a series. In the foreword, the editor states: ". . . the end *Advances in Chemical Engineering* seeks to serve is to provide the engineer with critical running summaries of recent work: some that bring standard topics up to date; others that gather and examine the results of new or newly utilized techniques and methods of seeming promise in the field. Thereby, we hope to help practitioners of the chemical engineering art to keep abreast of the flood of information they are creating." This is a very worthy objective and one that badly needs attention.

This volume covers seven fields: (i) boiling of liquids; (ii) non-Newtonian technology—fluid mechanics, mixing, and heat transfer; (iii) theory of diffusion; (iv) turbulence in thermal and material transport; (v) mechanically aided liquid extraction; (vi) automatic computer in control and planning of manufacturing operations; (vii) ionizing radiation applied to chemical processes and to food and drug processing.

In the main, this volume accomplishes reasonably well those objectives mentioned in the preface. However, as with so many volumes in which the separate chapters are written by different people, the change of pace and method of approach used by the different authors are disconcerting to the reader. In each case, the bibliography of references at the end of individual chapters appears to be quite complete and is of great value to the reader who is engaged in serious research in that particular area.

One very interesting commentary on the times is the notation on the source of support which some of the authors had for their research program. Without the support of such federal agencies as the National Science Foundation, the Office of Naval Research, the Office of Ordnance Research, and the Atomic Energy Commission, much of the information in the book would not be available.

For the reader who wishes to keep abreast of the developments in the seven fields covered in this volume, the value of the individual chapters seems to be inversely proportional to the amount of mathematical treatment in the chapters.

The chapter on "Boiling of liquids" illustrates this point. It is written in a very interesting style, but many of the mathematical manipulations have to be taken on faith, unless the reader is an active worker in the area. However, the author does get over his point and shows how little is actually known about such a simple process as boiling. He emphasizes the need for the development of very careful experimental techniques in order to obtain duplicate meaningful results. This contribution alone makes this chapter worth while.

The inclusion of the chapter on "Non-Newtonian technology" (fluid mechanics, mixing, and heat transfer) is a valuable addition to the literature, since few chemical engineers understand the meaning of this subject, and engineers other than chemical have even less cognizance of the subject. The chapter will be of particular value to those who are concerned with manufacture of objects from plastic raw materials.

The chapter on the "Theory of diffusion" contains a large amount of material, garnered from a variety of sources, which has not appeared previously in such concise form. The chapter constitutes a good source reference and gives clues on how to solve a large variety of problems, but in many instances the information is not complete in itself, and the reader must refer to the original literature. This is to be expected in a condensation of this sort.

The chapter on "Turbulence in thermal and material transport" illustrates the difficulty in basing conclusions on incomplete data. The author states: "At present the background of experimental data is sufficiently sparse that most of the prediction of the influence of turbulence upon transport must be made by analogy." If the chapter will stimulate research to answer some of the unknowns, it will have accomplished its purpose.

The chapter on "Mechanically aided liquid extraction" contains some useful descriptive information on means for accomplishing extraction. The mathematics in the chapter detracts from, rather than improves, the reader's understanding of the process involved. The qualitative descriptions are quite good.

In the chapter on "The automatic computer in the control and planning of manufacturing operations," the author has managed to cover the field of usefulness of computers very well in a short space. Although this is not the first time that this has been attempted, in my opinion this is the best condensation to date.

"Ionizing radiation applied to chemical processes and to food and drug processing" is the subject of the final chapter. The authors do a fine piece of work in exploding certain myths about the use of radiation processes. At the same time, they pinpoint the areas where the use of new techniques is very promising.

I consider this volume a worth-while contribution to the literature of chemical engineering in two respects: (i) it brings the general reader up to date in seven diversified areas (he will lose little if he skips the mathematical presentation); and (ii) the active research worker in these fields will find the summaries useful and the literature references valuable.

RALPH MORGEN
Purdue Research Foundation

Engineering Structural Failures. The causes and results of failure in modern structures of various types. Rolt Hammond. Philosophical Library, New York, 1957. 224 pp. Illus. $12.

The scant literature on structural failures is considerably enriched by this work. Except for a few technical articles on the cause of failures (the number of which is in sharp contrast to the large number of descriptions of successes in engineering work), there have previously appeared only a short book on *La Pathologie du Beton Arme*, by Henry Lossier (1952), and a translation of the 1854 work of Alexandre Colin on *Landslides*, by W. R. Schriever (1956). In recent years I have had published several lectures on the causes and lessons of structural failures, and in so doing, have been subjected to some criticism for suggesting an open forum where all may learn from mistakes made. It is quite evident that the author is similarly restrained, and that much available information is not included in his book.

Eight general classes of engineering structures and problems are covered: earthworks, dams, maritime structures, buildings, bridges, underground works, vibration problems, and welded structures. A chapter follows on "Lessons of failures." If the author had not deviated from his topic by including several interesting and informative discussions not pertinent to the subject, space would have been available for more examples of the many recorded failures in each of the classes covered, thus making it possible to show the generally consistent patterns which seem to be conducive to "incidents" in engineering structures.

The random samples of earthwork

failures described provide a weak analysis of causes; much more authentic data are available in the numerous reports in the field of soil mechanics issued since 1930. It is out of the report of such failures that the new science of soil mechanics was born and developed. The author's grasp of this subject is less complete than his knowledge of construction techniques. Only a few spectacular dam collapses are described, yet the lesson of the Fort Peck failure is omitted. The discussion on arch-dam design seems out of context for this book. Similarly, the chapter on maritime structures gives us a good introduction to design and forces acting and a complete theory of wave action, but very few examples of the many sea-wall and groyne failures.

In the chapter on buildings, there are descriptions of five building failures in the United States, from 1901 to 1924. There are available many examples of more recent construction design and practice which would be of greater interest. (Strangely enough, no examples are given of building failures in the country —England—of this book's origin.) The description of the troubles with expansive clays (the author calls them "shrinkable clays") is not a complete story; much better information is found in the soil reports from Texas, Canada, and Southern Rhodesia.

Again, the chapter on bridges goes into great detail on the Quebec and Tacoma bridge collapses but misses the opportunity to teach the lessons of distress in small-bridge designs and of the typical erection failures.

The section on failures of underground structures includes a dissertation on the theme that soil is not a static material, and that tests of pressures are possible, but only two tunnel failures and one shaft failure are described, with no correlation to the theoretical discussion. Some mention should have been made of small-tunnel and conduit failures and of the recent Wilson Tunnel incident in Hawaii.

Vibration problems are well presented by the description of techniques of vibrograph recording of earthquake, blasting, and machinery effects, but the description of insufficiency in actual designs is not covered. Almost the entire chapter on welded structures is devoted to a discussion of steel metallurgy, brittle fracture, and metals of low fatigue strength. The description of welded steel ship failures is good—as is the author's vindication of the preference for welded over riveted ship design.

The concluding chapter has a misleading heading, since no lessons of failures are given. Instead, the author has described modern instruments for stress determination and for full-scale tests of structures. He has done an important service in opening up the literature on the subject but has not provided good coverage and has missed an opportunity to fill the gap in engineering knowledge.

It has been said that doctors bury their mistakes and architects plant ivy. Engineers write reports and then bury the lessons to be found therein.

JACOB FELD

New York, N.Y.

Elements of Partial Differential Equations. Ian N. Sneddon. McGraw-Hill, New York, 1957. 327 pp. Illus. $7.50.

Partial differential equations are a subject of greatest interest, both to mathematicians and to research workers in many fields of theoretical and applied science. In spite of this, the existing literature in the English language that is accessible to the nonspecialist in this field is scanty indeed. The book by Ian N. Sneddon, a worthy successor to the same author's book on Fourier transforms, will contribute much to filling this gap. It deals with Pfaffian systems, linear and nonlinear partial differential equations of the first order (including systems for one unknown function) and, briefly, with general equations of second and higher order, while the potential, the wave, and the diffusion equations are treated in separate chapters, with considerable detail. A large variety of methods, developed for the different types of problems and found in many separate treatises—such as reduction to ordinary differential equations by use of the characteristics; operational calculus; Fourier, Laplace, and other integral transforms; separation of variables and expansions in eigenfunctions; potentials with prescribed singularities; conformal mappings; integral equations; and direct methods of the calculus of variations—are discussed extensively or at least touched on in this book.

However, no systematic treatment of these methods is attempted. The author's aim is to take up only problems that have more or less explicit solutions and to concentrate on the methods only insofar as they yield these solutions in the most direct way. Very few complete proofs are given, but most methods discussed are illustrated by fully worked examples. Most of the problems, of which there are many in each section, are far from routine. Some of them extend the theory considered in the body of the text, others serve to show the manifold use of the general results.

Some readers will regret certain omissions and details of the treatment. One misses a general discussion of the reasonableness of the various initial and boundary-value problems (the concept of "correctly set problem" is not mentioned), a discussion of systems of equations like Maxwell's and Navier-Stokes', a general definition of Green's functions and elementary solutions and of the characteristics as branching strips, and many other general concepts. There are few uniqueness theorems, the eigenvalue problem so important in the theory of vibrating media is hardly mentioned, and numerical methods are ignored. Nevertheless, the merits of this book are so obvious that its wide use as a textbook for students and as a source book for research workers in many fields of science can be safely predicted.

MICHAEL GOLOMB

Purdue University

The Sun. Giorgio Abetti. Macmillan, New York, 1957 (translation J. B. Sidgwick of 1954 revised edition). 336 pp. Illus. + plates. $12.

The first edition of *The Sun* by Giorgio Abetti has been a standard reference book for 15 years. The present edition, although it follows the general style and form of the first, is completely rewritten. New theories of the sun and new techniques for observing it are described in detail, but earlier achievements of historical interest are not neglected.

Abetti reviews faithfully, although necessarily briefly, what has been written about the sun in all languages through the years. His presentation is factual. It is an unprejudiced, noncritical statement of observational and theoretical accomplishments and may not seem exciting enough to those who like to have everything presented with a positiveness beyond its worth. The following quotation from the end of the chapter on the theories of the sun's constitution illustrates his conservative approach: "The theories that we have been glancing at are still speculative, and it cannot be said that a complete explanation of the complex phenomena of the Sun has yet been evolved." Not a single chapter is dominated by the pet theories of the author.

The second edition, like the first, was written in Italian, Abetti's native tongue, and the translator has preserved the full flavor of the author's style.

The Sun, illustrated with many photographs and drawings, is not a technical book; it can be read and enjoyed by anyone interested in undramatized details about the sun and about the men and instruments that brought these details to light. Its value as a reference book would be increased by a longer bibliography, but as a self-contained solar encyclopedia, *The Sun* will be difficult to excel.

SETH B. NICHOLSON

Mount Wilson and Palomar Observatories

The Milky Way. Bart J. Bok and Priscilla F. Bok. Harvard University Press, Cambridge, Mass., ed. 3, 1957. 269 pp. $5.50.

This is an excellent book, as were the two earlier editions, and the Harvard University Press dresses up the new volume in a very attractive format.

The first two chapters provide general background information: a description of the visual and photographic appearances of the Milky Way and a useful schematic model of the system, a summary of astronomical coordinates, examples of various kinds of telescopes, and an outline of the basic data of observation used in Milky Way research. The importance of cooperation in research is stressed, with special mention of the influence of the International Astronomical Union and the fact that "the National Science Foundation is taking the lead in promoting the growth of cooperative research facilities in the United States; a National Radio Observatory and a National Optical Observatory are important items on the high priority list."

The third and fourth chapters discuss the structure of the galaxy, from the sun's nearest neighbors to the distant globular clusters and the nucleus of the galaxy. The importance of the Hertzsprung-Russell diagram and of Baade's fruitful concept of the "two stellar populations" are fully explored. Blaauw's discovery of the expansion of the Zeta Persei association and subsequent work by Blaauw and Morgan on other associations have opened up a new field since the second edition appeared in print. The change in the zero-point of the classical Cepheids, with the consequent doubling of the distances of the external galaxies, has also come since the publication of the second edition.

Stellar motions, a valuable source of information about the physical properties and dimensions of the galaxy, are reviewed in chapter 5. The interstellar medium is thoroughly discussed in chapters 6 and 7.

The revolution in Milky Way research that has been brought about by radio astronomy is described in chapters 8 and 9. The remarkable work by Morgan and his associates in tracing the spiral structure of our galaxy in the sun's neighborhood was followed, in less than a year, by the Dutch radio results, which traced an outer arm halfway around the galaxy. Australian observations are filling in the rest of the picture.

Long-time evolutionary changes in the galaxy and the cosmic time scale are taken up in the final chapter.

On the very day this review was written, Bart Bok arrived in Australia to take up his new duties as director of the Mount Stromlo Observatory. Anyone who reads this book will realize how serious is our loss and how great is Australia's gain.

FRANK K. EDMONDSON
National Science Foundation

Arizona's Meteorite Crater. Past, present, future. H. H. Nininger. American Meteorite Museum, Sedona, Ariz., 1956. 232 pp. Illus. $3.75.

The meteorite crater in northern Arizona is an outstanding topographic feature of the earth's surface and has attracted great attention. The crater has been well known since 1870. By 1909 its topographic features had been exhaustively described, and the most serious investigators agreed with the view that the crater was blasted out by the impact of a large meteorite. It is our largest authenticated meteorite crater. Since then, numerous surveys have been made of the crater, with various objectives in mind. In the main, these surveys were conducted by the Barringers, who are intent upon locating and, if possible, recovering the large meteorite that made the crater, and by Nininger, who has considerable scientific curiosity concerning the crater and who was also interested in augmenting his museum collection. It is fitting, therefore, that Nininger should summarize the information that is available on the crater. In general, he makes an exceedingly thorough and splendid job of the summary.

He describes the early history of the crater and the researches and surveys that have been carried on there and reviews critically all the findings to date. I found no serious omissions. In addition, he speculates extensively on the nature of the event that took place at the time of the earth's encounter with the meteorite. When did it strike? How fast was it moving? From what direction did it come? How large was it? Was it a single large meteorite or a swarm of meteorites? In many instances, his speculations are unsatisfying and inconclusive. This stems from the paucity of the data he has to work with and from his own enthusiasm. He takes the view that no large body of meteoritic material now lies buried in the crater.

There is a certain undercurrent of personal differences running through the book, but I found this more unfortunate than objectionable.

The book is well and interestingly written. It has both popular appeal and considerable scientific merit. The illustrations are excellent and the type is good. The very extensive bibliography will be of great help to anyone doing research on the crater.

JOHN S. RINEHART
Smithsonian Astrophysical Observatory

Dynamic Meteorology and Weather Forecasting. C. L. Godske, T. Bergeron, J. Bjerknes, and R. C. Bundgaard. American Meteorological Society, Boston, and Carnegie Institution of Washington, 1957. xvi + 800 pp. Illus. $15.

This remarkable treatise is a fitting monument to the memory of Vilhelm Bjerknes, the great leader of modern meteorology. Written by four of his closest associates, of whom two were his active partners from the early days of frontology, the book is produced in continuation of the earlier works: *Dynamic Meteorology and Hydrography* (1910) and *Hydrodynamique Physique* (1933) by V. Bjerknes and various collaborators. As a monument, it is both massive and elegant.

The conception of the book goes back to about 1935. In the foreword we read that the manuscript was completed in 1948, was submitted for publication in 1951, and was finally published in 1957. Although not explained, the circumstances underlying this delay are readily understood and reflect the difficulties encountered nowadays when it comes to publishing a work of extraordinary dimensions, except in the rare cases where there is a ready market.

Progress in theoretical meteorology, as well as in other branches of geophysics, depends on talent, with thorough background in classical physics. More than 50 years ago, V. Bjerknes set out to transform meteorology into a branch of classical physics. As early as 1904 he formulated the problem of weather forecasting as an initial value problem. In our time, when teaching of classical physics in the universities has been pushed into the background, to give space for nuclear physics, electronics, photography, and so on, it is refreshing to read *Dynamic Meteorology and Weather Forecasting* and to find that its roots are where they truly belong. Undoubtedly, the authors have set an example and a standard which cannot easily be ignored.

The book is divided into five major parts. Although a complex science does not readily lend itself to division into compartments, the arrangement is logical and convenient. The first three parts deal with (i) thermodynamics and statics, (ii) kinematics, and (iii) hydrodynamics. This is what is commonly called theoretical meteorology, and nowhere else will one find a treatment which is so complete and inspiring as the one here given by the principal author, C. L. Godske. On occasions, and particularly in the treatment of simple atmospheric motions, one could wish that fewer details had been included, but the chapters and sections are so well arranged, and the headings are so eloquent, that large portions may be skipped without loss of

continuity. The reader will miss a treatment leading up to numerical prediction of motion systems. Although this is regrettable, particularly in view of V. Bjerknes' early formulation of the initial value problem in meteorology, it should be remembered that the manuscript was completed in 1948 before any substantial development took place in this most modern branch of meteorology.

Part IV, which is written mainly by J. Bjerknes and T. Bergeron, is called "Climatological and synoptic models." It is more than this. It is an extraordinarily cogent presentation of atmospheric structures, characterized by great simplicity and a wealth of information, and it is well connected with the foregoing theoretical parts. This, indeed, is pleasant reading.

Part V, which deals with weather forecasting, may be criticized on many scores, but, again, it should be remembered that the manuscript was completed in 1948, before the practices developed during World War II could be properly evaluated and the winnowing process completed. The presentation is often formalistic and shows little connection with the treatment in the theoretical parts. One may question the wisdom of including, in a treatise of this kind, descriptions of meteorological codes and operational practices, the life of which is not comparable with that of a basic text. In reading the historical notes one becomes impressed with the difficulties in the way of avoiding bias.

At the end, one may well ask: what use can the book be put to? Will it be used in instruction at the university level? On the whole, it is a book for researchers and instructors rather than for students, and, as such, it will do much to raise the level of learning. One may hope that it will be often revised and kept up to date. Like all true monuments, it should enjoy a long life.

The meteorological profession will be grateful to the authors for the immense work that has gone into the writing and to the American Meteorological Society and the Carnegie Institution of Washington for the excellent manner in which the book has been produced.

SVERRE PETTERSSEN
University of Chicago

Social Sciences

The Structure of a Moral Code. A philosophical analysis of ethical discourse applied to the ethics of the Navaho Indians. John Ladd. Harvard University Press, Cambridge, Mass., 1957. 474 pp. $8.

The empirical part of this book undertakes, primarily through the interviewing of selected wise men of a Navajo community, to elicit and exhibit the moral code of that particular nonliterate society. But John Ladd, a philosopher by trade and training, has not merely done extracurricular service in an alien discipline. He has also endeavored to frame a general theory and methodology for descriptive ethics, the latter being distinguished, on either side, from overt moral teaching and from philosophic analysis of moral utterances. The method he has outlined and employed is presumed by him to be available and utilizable by any anthropologist who may wish to discover and reconstruct the moral code of any group whatsoever.

The moral code of a group is imbedded in the general ethical system of that group, while the ethical system also includes the "ethical conceptions and argumentation" to which the group subscribes. To disinter a moral code is to do a bit of social science, in the sense that a proper reconstruction of the code will, ideally, permit both explanation and prediction of the sorts of moral statements likely to be uttered by members of the group over whom the code holds. The reconstruction will, however, not permit either prediction or explanation of the *conduct* of those individuals, nor will observation of their conduct apparently help in determining their moral code.

The author is quite resolute in excluding matters of behavior from consideration, though his reasons for doing so, if understandable on the practical level (he spent about 5 weeks "in the field"), are theoretically questionable. Most of us, after all, would regard, as the most decisive evidence of a man's moral beliefs, not what he says but the way in which he makes choices. And it must seem perverse or arbitrary when someone proposes that "evidence (such as actual behavior) will be considered irrelevant."

So far as Ladd's technique of reconstruction is concerned, it seems chiefly to consist in finding major premises for arguments which natively occur as enthymemes—that is, where prescriptive conclusions are directly drawn from factual premises. Thus, "don't steal, because it will get you in trouble!" can be validated as a piece of moral reasoning (and can be effective as a piece of moral dissuasion) only in cases where the parties who utter and heed it are prepared to adhere to the missing prescriptive premise, "don't do anything that will get you in trouble!" When this same major premise is found to be required by a significantly large number of moral arguments, one is likely to have a "basic prescription" in one's hands, and accordingly the logical wherewithal to deduce (hence, predict) specific prescriptions—provided that one is also aware of what sorts of acts are regarded as trouble-producing. Different groups will, of course, wield different basic prescriptions, and wield them in different ways, but a given group may be depended on to wield its basic prescriptions in a manner sufficiently consistent to allow some general characterization of that group's ethical slant.

The ethical slant of the Navajos, according to the thesis advanced here, is both "teleological" and "egoistic." That is, an action which is morally relevant must (i) produce (or avert) some "end-state-of-affairs," and (ii) the latter must in some sense conduce to the personal welfare of the individual agent. Accordingly, the typical Navajo may be expected to be unmoved by other kinds of moral reasons—for example, that an act is forbidden from on high, or will conduce to the social good, or has been sanctioned by ancestral practice. One verifies these theses by asking leading questions and seeing whether or not the anticipated responses are forthcoming. Within the limits he sets himself (namely, to restrict himself exclusively to verbal evidence), I should say that Ladd's reconstruction is reasonably well verified. He is a good interviewer and, despite a formidable linguistic barrier, manages to get his informant to think about certain moral situations which, though almost classical in our ethical experience, are clearly novel to the Navajo.

The book suffers from that kind of running methodological patter which lengthy books in the social sciences so often display. And Ladd's epitomization of the Navajo code as "a Hobbesian ethical system, modified by an Epicurian psychology and a Spinozistic sociology" sounds just the sort of crashing chord that will lift the spirits of some men and set other mens' teeth on edge.

ARTHUR C. DANTO
Columbia University

The Foundations of Science and the Concepts of Psychology and Psychoanalysis. vol. I of *Minnesota Studies in the Philosophy of Science.* Herbert Feigl and Michael Scrivens, Eds. University of Minnesota Press, Minneapolis, 1956. 346 pp. $5.

In the tradition of the close relationship that has prevailed for the past few decades between the philosophy of science and the science of psychology, the Minnesota Center for the Philosophy of Science has published a volume containing a dozen methodological papers (several of which have been published elsewhere) that are directed at the behavioral sciences. The combined papers, especially those of the members of the center (Feigl, Meehl, Sellars, and Scriven), do not offer any methodological

panacea for psychology, nor for that matter do they offer any consistent point of view. At best they represent an exceedingly pragmatic approach to the philosophy of science, with emphasis on the meaning of concepts in terms of their locus in the "nomological net."

The 12 papers fall into three categories. One set contains the more or less traditional philosophy of science paper dedicated to analysis of the epistemological basis of modern science. Feigl argues convincingly for a sharp and clear distinction between analytic and synthetic statements. Carnap proposes an empirical criterion of factual meaningfulness and distinguishes between theoretical concepts and dispositional concepts. This latter point is very timely, considering the confusion that has been generated by psychologists who fail to make such a distinction. Meehl and Sellars, although they deny adherence to any emergentist formulation, argue that such formulations are logically defensible: "As we see it, the question whether the world is to be conceived along emergentist lines is a scientific question which cannot be settled on a priori grounds." Sellars, in a lengthy article, attacks the sense-datum theories of knowledge and finally leaves the reader at a crossroads with no signposts.

The second group of papers is dedicated to psychoanalysis. First, a vigorous and often, if not always, successful attack on psychoanalysis is undertaken by *l'enfant terrible* of American psychology, B. F. Skinner. Scriven replies in kind by directing his scorn at Skinner's radical behaviorism while half-heartedly defending psychoanalysis. Scriven notes, and I agree, that "Skinner's position on almost every issue admits of two interpretations—one of them exciting, controversial and practically indefensible; the other moderately interesting, rather widely accepted, and very plausible." Scriven agrees with others who have argued that Skinner, despite his denials, has really proposed a theory. Possessing a methodological distaste for theories, Skinner finds himself in the enviable position of not having to defend his own theory. In spite of his methodological naivete, or perhaps as a result of it, Skinner remains one of the most original and creative modern psychologists. Two other papers, one concerned with an operational reformulation of psychoanalysis and the other denying the possibility of a logical reduction of psychoanalytic theory to physicalistic terms, conclude the section on psychoanalysis. It is a pity that so many contemporary philosophers and scientists feel compelled to analyze, interpret, and reformulate Freudian theory. Freudian theory is in much greater need of reliable empirical data than of theoretical refinement.

Perhaps the most constructive portion of the book deals with specific psychological topics. Cronbach and Meehl clarify the important and intimate reciprocal influence that can exist between psychological tests and psychological theory. Meehl demonstrates convincingly how an actuarial characterization of a person is superior to one formed on the basis of clinical judgment. Buck critically examines the logical status of general behavior systems theory and finds it wanting in all important aspects. And, finally, Scriven advocates a position that will be unpopular with tough-minded psychologists—namely, that there are some basic differences between the natural sciences and the social or behavioral sciences that prevent the latter from ever achieving the theoretical achievements of the former.

All in all, the book is an interesting one. It certainly justifies the fascinating sociological experiment known as the Minnesota Center for the Philosophy of Science. Those who read it will await with interest the publication of succeeding volumes.

HOWARD H. KENDLER
New York University

Perspectives in Personality Theory. Henry P. David and Helmut von Bracken. Basic Books, New York, 1957. 435 pp. $6.50.

In June 1954, when the 14th International Congress of Psychology convened in Montreal, the program committee was guided by a conviction that "one of the great challenges to the International Union is not merely to bring psychologists of different nations together, but specifically to break down the parochialism of American psychology." This symposium volume, growing out of the congress, reflects this conviction.

Reviews of German, Swiss, British, French, and Italian psychologies of personality are supplied by eminent men from each country. Separate chapters are written by European psychologists whose names are associated with particular concepts or methods little known in the United States: phenomenology; existential psychology; stratification of the person; will; and character. Because these chapters and American rejoinders are presented in large perspective by excellent people, the book becomes an authoritative, world-wide picture of today's science of personality. Selective bibliographies after each chapter and a well-organized annotated 324-title bibliography in the appendix will rightly guide the reader whose interest is whetted into exploring unfamiliar literatures. Had the 14th congress accomplished nothing save generating this volume, its convening would have been worth while.

Strikingly, the psychology of each nation reflects that nation's culture. As McClelland points out: "One could make a case for the French insistence on absolute clarity and rationality of constructs, the Anglo-Saxon willingness to adopt a construct or hypothesis tentatively, however imperfect, so long as it leads to further research, the German preference for polarities, 'feeling with' another person and for hierarchical models." Are these national trends visible in other sciences?

To what extent is American psychology culture-bound? McClelland goes on to suggest that "American psychologists have had a strong interest in overt adjustment to the environment . . . because they were in a new country which demanded major adjustments from immigrants" and for other historical reasons. Also, the Strong Vocational Interest Blank, validated on an American sample, shows scientists in general to be "turned outward toward the world and away from their inner thoughts and experiences." Insofar as American psychology reflects this trend, adopting an anti-intraceptive definition of what is "scientific," remaining mechanistic, focusing on part-problems, ignoring the more unalterable aspects of man and refusing to examine what seem to be unpalatable sides of human nature, it clearly deserves to be called "ethnocentric."

After reading this book, one feels, however, that the pro-European contributors want to extend such an accusation unduly, to include the touchstone of empirical validity by which ideas are evaluated in American science. They appear to stretch the ideal of international tolerance to cover a demand that all ideas be assigned equal worth in the intellectual market place. I am not sure whether they therein display sophistication or sentiment. If some Continental thinkers are willing to honor untested ideas, must we feel that "the provincialism of American psychology" is revealed when Americans refuse to credit these ideas until their advocates show how they stand up to empirical test?

CHARLES MCARTHUR
Harvard University

Theories of Personality. Calvin S. Hall and Gardner Lindzey. Wiley, New York; Chapman and Hall, London, 1957. 572 pp. $6.50.

Hall and Lindzey have rendered a valuable service to teachers and students by collecting, under one cover, a description of 12 significant theories of personality. Four chapters are devoted to Freudian theory and several of its derivatives and deviants, like Jung, Adler, Sullivan, and Murray. Lewin, Allport, Rogers, and

Murphy receive one chapter each. A chapter each is devoted to organismic theories, constitutional psychology, factor theories, and stimulus-response theories of personality. In some cases, notably Jung's, the authors have collated writings from widely diverse sources that would be almost inaccessible to the usual teacher.

The various theories are so different in intent and coverage that they are not truly comparable, but insofar as possible, the authors follow a systematic outline in presenting each theory. They begin with biographical data, then describe, in turn, the structure, the dynamics, and the development of personality as conceived in the theory. They end each chapter with research that has stemmed from the theory and a short evaluation of its current status.

So far so good, and these valuable contributions must not be underrated, but the authors missed the golden opportunity to do even more. Their discussion recapitulates rather than illuminates. Perhaps because of their desire to be accurate, the authors rarely try to give the reader more insight than he would get from the original. Where Jung or Sullivan or Murphy is obscure or ambiguous, so are Hall and Lindzey. This is too bad, because the originators of ideas are not necessarily their clearest expositors.

The authors present a final integrative chapter that is quite useful, as far as it goes, but again fails to achieve what it might. The profession badly needs serious comparative studies of personality theories, somewhat analogous to literary criticism. Particularly when theories are poorly operationalized, it is not obvious just what is the function of any concept; it is partly a proposal to account for facts but is also an expression of the author's general convictions about human nature. When theories are denotative, it is important to recognize where they contradict each other, where they differ in language only, and where they address themselves to different bodies of data. An attempt to analyze personality theories in these terms would be daring, but we need people who will accept the challenge. My appreciation for what Hall and Lindzey did accomplish cannot but be tempered by my regret that they did not set themselves the genuine task of true psychological "criticism."

ALFRED L. BALDWIN
Cornell University

Archaeology and Its Problems. Sigfried J. De Laet. Translated by Ruth Daniel. Macmillan, New York, 1957. 136 pp. Illus. + plates. $4.50.

This little book, originally (1949–50) a short article in Flemish, was "not in the first place written for the reader, but more for the benefit of its author, who was trying to clarify his thoughts upon certain problems of methodology which had been preoccupying him for a long time" (page 11). It was expanded and translated into French in 1954; from this version the present English edition is derived, with slight modifications. *Archaeology and Its Problems* therefore reflects primarily the problems of the archeologist in Belgium and northern France, and, in discussing these, the author warns his British colleagues "against accepting continental archaeological material on equal terms with Scandinavian and British evidence" (page 10), since the latter is usually excavated, preserved, and interpreted according to higher professional standards. Many of the problems in practical matters, however, are ones with which his colleagues all over the world have had to struggle.

The author does not have to make a personal apology. His work exhibits the broad appreciation of the scope of archeology and of its relationship to other disciplines, the command of technical skills, the theoretical insights, and the sound judgment that mark the scholar and scientist of distinction. The American reader, whose own knowledge may be limited to problems and conditions peculiar to New World archeology or to techniques especially developed or in vogue in this country, will find this book especially illuminating, because the discussion is focused predominantly on current methodology and results in northern Continental Europe. There is also a wealth of concrete detail, drawn from the whole field of Old World archeology, which ranges from the Paleolithic to the Middle Ages and from Egypt to Scotland. Many of the particular techniques perfected in Europe should be more widely applied in this country.

The author's interpretation of data not only can be used as a model of what the archeologist should or should not conclude from the excavated remains and auxiliary evidence but also can serve to correct certain notions on the history of European culture that we may have drawn from less judicious summaries. Thus, he writes: "How often has a theory of migration or invasion been based purely upon the distribution of a pottery type, a weapon, or a burial custom? . . . so great is the detail and assurance with which these scholars recount the facts that one might be reading the chronicles of an historic epoch, left as a record of the chroniclers themselves. I, however, believe that for the most part dust is being thrown in our eyes" (page 119). And the author proposes his own more convincing, and far more stimulating, explanations of the data in question.

What illumines De Laet's work is not simply his competence as an archeologist but his profound appreciation of the wider field of anthropology, that science of culture in general, which, more than history or history of art or philology, gives full significance to the archeologic record.

De Laet writes with charm and vigor, and the translation is so excellent that we have no feeling that we are groping for his thoughts through the medium of an alien idiom. Although no concession is made to "human interest," as in the recent spate of popular books which describe the spectacular achievements of notable archeologists, this is really more exciting and satisfying reading, for it answers our legitimate questions. It is not only a book for the scholar's library but one that he can give to friends or recommend to students, and one that he will also want to keep on his bedside table.

FREDERICA DE LAGUNA
Bryn Mawr College

Bones for the Archaeologist. I. W. Cornwall. Macmillan, New York, 1956. 255 pp. Illus. $10.

Meeting Prehistoric Man. G. H. R. von Koenigswald. Translated from the German by Michael Bullock. Harper, New York, 1957. 216 pp. Illus. + plates. $3.50.

Of the two works reviewed here, the first, as its title indicates, is intended as a manual that will enable the archeologist to make at least rough identifications of the vertebrate remains found in association with human bones or cultural debris. The second volume is a simple, nontechnical account of the experiences of G. H. R. von Koenigswald while searching for fossil man and his interpretation of his own and other workers' discoveries. Since bones have to be identified before they can be interpreted, we will begin by discussing I. W. Cornwall's book.

As F. E. Zeuner points out in the foreword, there is a surprising dearth of works that treat of this subject, and we must thus recognize that whatever the faults of this volume may be, it is a sincere and well-intended effort to provide a handy textbook for that obscure region lying between the paleontologist and the student of extinct cultures. Unfortunately, I cannot endorse the volume as entirely successful from an American point of view.

In the first place, although Macmillan has chosen to issue the book in the United States, the author has deliberately ignored those animal groups which are so important at present to the New World archeologist. He has confined himself to the Old World vertebrate fauna, and thus the hopeful American

student finds little or nothing to help him in his encounters with the fragmentary remains of extinct American bisons, sloths, camels, and other Pleistocene forms. At best, only certain Old World species are available in some intercontinental families.

There are additional faults. The book lacks an index, and, for any volume intended as a handbook of instruction, such a lack is crippling indeed. One cannot avoid the impression that, from the standpoint of a short course intended to transmit a maximum of practical information to workers in another discipline, the volume is excessively bookish. More careful selection would have obviated this difficulty, shortened the book, and intimidated fewer beginners. Although considerable attention is paid to the human skeleton, there has been no attempt to discuss certain anomalies and pathologies which occasionally excite attention in the field—anomalies such as the metopic suture or parietal fenestrae for example. No account is given of the use of the *Dryopithecus* pattern in primate-human identifications, nor does the author mention the crenulation which is so typical of orang teeth. A number of the illustrations of the occlusal surface of the primate dentition are so small that detail is obscured. There are other sins of omission and commission which will force the instructor to return to the older, more standard osteologies, such as Flower, or augment his material from other sources.

Cornwall has obviously expended a great deal of labor and time upon his book. I do not wish to minimize the difficulties he must have encountered or the compromises he must have had to make. A start in a somewhat unorthodox instructional field is always difficult. It may well be that only when such a course as Cornwall teaches is more widely installed in archeological departments will we be in a position to pool our experience in a more satisfactory and useful textbook. Cornwall has made a brave, singlehanded start, and I, for one, hope he will not be deterred from future revisions of his pioneering attempt by any grumbling from the sidelines.

Turning now to von Koenigswald's little volume, *Meeting Prehistoric Man,* we enter on an exciting world in which von Koenigswald himself has played a leading role as an explorer and discoverer in the Pleistocene fossil beds of Java. We owe largely to his efforts and to those of his faithful Javanese assistants the discovery of *Homo modjokertensis* (Weidenreich's *Homo robustus*) from the Sangiran deposits that predate the Trinil beds which yielded Dubois' original specimen. We also owe to him the recognition of *Gigantopithecus blacki,* from China, and of *Meganthropus paleojavanicus.* He contributed to the investigation of the Ngandong beds which yielded *Homo soloensis.*

This volume, therefore, instead of being one of that numerous and perennial crop of fossil-man books turned out by itinerant journalists, is the valuable record of a man who was on the spot at great discoveries and who is a professional scientist. The book is a simple, straightforward account of von Koenigswald's travels, discoveries, and contacts with other distinguished workers in the field. We are told of the cantankerous and eccentric behavior of Eugene Dubois, who seems to have viewed all fossils but his own with suspicion and dislike. We see Davidson Black, the first describer of *Sinanthropus,* laboring, with broken health, to complete his studies and dying alone in 1934 in Peking, with the precious skull clutched in his hand. We haggle for "dragon bones" in Chinese drugstores. We contend with native collectors who strive to augment their income by breaking the precious fossils into smaller pieces in order to be paid for each fragment. The world of the bone-hunter—its hopes, frustrations, disappointments, and assorted eccentrics—passes before our eyes.

From the professional standpoint, von Koenigswald clarifies the position of the Sangiran beds in relation to Trinil and contends that the massive-faced *Pithecanthropus* of that level (*modjokertensis*) is ancestral to the later *erectus.* He clings to the now doubtful position that *Gigantopithecus* is a giant form because "all extant Primates exhibit an harmonious relationship between size of dentition and body size." Curiously enough, the author, in a later chapter on the South African man apes, discusses the extremely massive mandible of the normal-sized *Paranthropus crassidens* without ever returning to a consideration of the point just quoted, about which questions would now have to be raised.

Von Koenigswald regards the Australopithecines as not on the main line of human ascent, in this way differing from most of his South African colleagues. Human paleontology is far from being an exact science, and, as finds multiply, anatomic and geologic complications are often viewed differently by careful and sincere workers. It is so in this case. Points can be made on both sides of this argument, which threatens to be much in evidence for some time to come. The reader is urged to consult this volume and form his own opinions on many such disputed topics.

A few small errors of a factual and typographic nature should be noted, for correction in future editions. On page 66 the term *Pleistocene* has been inadvertently used when *Pliocene* was intended. Unfortunately, this can confuse students. On page 90 it is intimated that the American sabre-toothed tigers could scarcely open their mouths because of their huge canine teeth. This is a piece of paleontological folklore which persists in spite of being erroneous. As Colbert, among others, has pointed out, the jaw of *Smilodon* was mechanically specialized to permit a very wide gape. The notion propounded by von Koenigswald that the sabre-tooths were carrion feeders who used their canine teeth only to slit open the bellies of putrescent carcasses has a certain morbid and Poeesque charm. It accords ill, however, with American anatomic studies of these powerful, big game-hunting cats.

In the introduction, influenced by G. G. Simpson, von Koenigswald abjures orthogenesis. There are times, nevertheless, as in the story of the cats who died because their teeth had grown too long, when the ghost of this doctrine seems to haunt a few pages. In general, the book is wonderfully informative, and at the present stage of his science, what student of human paleontology can ever lay claim to being totally consistent! Von Koenigswald has blessed us with an intimate, modest, and friendly book. It is a great pity that the state of the world should have interrupted the investigation in Java of an area so rich in the remains of Pleistocene humanity. Without the labors so casually narrated in this little volume, our science would be a great deal poorer than it is.

LOREN EISELEY
University of Pennsylvania

New Books

Report of the Conference on Recent Developments in Cloud-Chamber and Associated Techniques. Comprising collected papers of the conference held under the joint auspices of the Physical Society of London and University College London in March 1955. N. Morris and M. J. B. Duff, Eds. University College, London, 1956 (order from Secretary, Physics Department, University College, London). 227 pp. 30s.

Molecular Structure and Functional Activity of Nerve Cells. A symposium organized by the American Institute of Biological Sciences and sponsored by the Office of Naval Research. Held in Washington, D.C., 3–4 June 1955. Publ. No. 1. Robert G. Grenfell and L. J. Mullins. American Institute of Biological Sciences, Washington, 1956. 169 pp. $4.75.

Vapor Phase Chromatography. Proceedings of the symposium sponsored by the Hydrocarbon Research Group of the Institute of Petroleum held at the Institution of Electrical Engineers, London, 30 May–1 June 1956. D. H. Desty, Ed.; assisted by C. L. A. Harbourn. Academic Press, New York; Butterworths, London, 1957. 436 pp. $12.

New **RONALD** *Books*

Principles of PLANT PATHOLOGY

ELVIN C. STAKMAN
J. GEORGE HARRAR

Ready in May. Authoritative treatment of the interrelationships between plants as economic resources and diseases that limit their productivity. Examines distribution of plant pathogens, etiology of major plant diseases. *149 ills., tables, 569 pp.* *$8.*

BIOLOGY and CONTROL of the SMUT FUNGI

GEORGE WILLIAM FISCHER
CHARLES STEWART HOLTON

Condensed yet comprehensive review of knowledge to date on the smut fungi and their role in human welfare. Treats phylogeny, morphology, taxonomy, etc., of smut fungi. *109 ills., 622 pp.* *$10.*

Companion Volumes (Published) . . . also by Fischer

- **Manual of the North American Smut Fungi** *136 ills., 343 pp. $8.75*
- **The Smut Fungi—A Guide to the Literature, with Bibliography** *387 pp. $8.50*

BIOGEOGRAPHY
An Ecological Perspective

PIERRE DANSEREAU

Offers a new synthesis of the environmental relationships of living organisms. Encompasses the study of botany, ecology, and geography. *177 ills., tables, 394 pp.* *$7.50*

Guide to Medical Writing

HENRY A. DAVIDSON, M.D.

Expert guidance on basic writing techniques for physicians, dentists, nurses, and pharmacists. Full of practical advice. *27 ills., 338 pp.* *$5.*

Interpersonal Diagnosis of Personality

TIMOTHY LEARY

A functional theory and methodology for personality evaluation. Book presents a series of complex techniques for measuring interpersonal expressions at different levels of personality. *120 ills., tables, 518 pp. $12.*

The SENTENCE COMPLETION METHOD

AMANDA R. ROHDE

Discusses diagnostic and clinical application of the sentence completion method to the treatment of mental disorders. Fully describes method's rationale, administration, scoring, and interpretation. *28 ills., tables, 301 pp.* *$7.50*

Order your books from:

THE RONALD PRESS COMPANY
15 E. 26th Street, New York 10

Truth and Meaning. David Greenwood. Philosophical Library, New York, 1957. 114 pp. $3.75.

Physics, a Modern Approach. L. Paul Elliott and William F. Wilcox. Macmillan, New York, 1957. 658 pp. $5.12.

Magnetohydrodynamics. T. G. Cowling. Interscience, New York, 1957. 115 pp. $3.50.

An Introduction to Electrostatic Precipitation in Theory and Practice. H. E. Rose and A. J. Wood. Essential Books, Fairlawn, N.J., 1956. 166 pp. $2.80.

The Fight for Fluoridation. Donald R. McNeil. Oxford University Press, New York, 1957. 241 pp. $5.

Aspects of River Pollution. Louis Klein. Academic Press, New York; Butterworths, London, 1957. 621 pp. $14.50.

Handbook of Snakes of the United States and Canada. vols. I and II. Albert H. Wright and Anna Allen Wright. Comstock Publishing Associates, Cornell University Press, Ithaca, N.Y., 1957. 1105 pp. $14.75.

Sir Richard Gregory, His Life and Work. W. H. G. Armytage. Macmillan, London; St. Martin's Press, New York, 1957. 241 pp. $5.

Modern Pulp and Paper Making. John B. Calkin, Ed. (previous editions by George S. Witham, Sr.), Reinhold, New York; Chapman & Hall, London, ed. 3, 1957. 549 pp. $10.

Disaster. A psychological essay. Martha Wolfenstein. Free Press, Glencoe, Ill., 1957. 231 pp. $4.

Chromosomes. Lectures held at the Conference on Chromosomes, Wageningen, Netherlands, 16–19 April 1956. Uitgevers-Maatschappij W. E. J. Tjeenk Willink, Zwolle, Netherlands, 1956. 231 pp.

Psychology You Can Use. Dorothy H. Yates. Crowell, New York, 1957. 248 pp. $3.95.

A Glossary of Mycology. Walter H. Snell and Esther A. Dick. Harvard University Press, Cambridge, Mass., 1957. 171 pp. $5.

Boy's Book of Frogs, Toads, and Salamanders. Percy A. Morris. Ronald Press, New York, 1957. 240 pp. $4.

Ernest Rutherford, Atom Pioneer. John Rowland. Philosophical Library, New York, 1957. 160 pp. $4.75.

Foundations of Radio. M. G. Scroggie. Iliffe, London; Philosophical Library, New York, 1957. 349 pp. $10.

The Horse-Flies (Diptera: Tabanidae) of the Ethiopian Region. vol. II, *Subfamilies: Chrysopinae, Scepsidinae and Pangoniinae and a Revised Classification.* H. Oldroyd. British Museum (Natural History), London, 1957. 489 pp. £4 10s.

Inventors and Inventions. C. D. Tuska. McGraw-Hill, New York, 1957. 174 pp. $3.75.

Psychological Tests and Personnel Decisions. Lee J. Cronbach and Goldine C. Gleser. University of Illinois Press, Urbana, 1957. 165 pp. $3.50.

The Fundamentals of Electric Log Interpretation. M. R. J. Wyllie. Academic Press, New York, ed. 2, 1957. 176 pp. $4.50.

Expectant Motherhood. Nicholson J. Eastman. Little, Brown, Boston, ed. 3, 1957. 198 pp. $1.75.

Index of Books Reviewed in SCIENCE, 27 April 1956 through 19 April 1957

Astronomy

Astrophysical Quantities, C. W. Allen (Athlone), 27 Apr. 1956, 735

The Changing Universe, J. Pfeiffer (Random House), 21 Sept. 1956, 541

Expanding Universes, E. Schrödinger (Cambridge Univ. Press), 24 Aug. 1956, 370

Gaseous Nebulae, vol. 3, L. H. Aller (Wiley), 16 Nov. 1956, 986

The Moon, H. P. Wilkins and P. Moore (Macmillan), 14 Sept. 1956, 490

The New Astronomy, Editors of *Scientific American* (Simon and Schuster), 27 Apr. 1956, 729

Biochemistry and Microbiology

Advances in Enzymology and Related Subjects of Biochemistry, vol. 17, F. F. Nord, Ed. (Interscience), 19 Oct. 1956, 730

Advances in Virus Research, vol. 3, K. M. Smith and M. A. Lauffer, Eds. (Academic), 27 Apr. 1956, 739

The Alkaloids, Chemistry and Physiology, vol. 5, R. H. F. Manske, Ed. (Academic), 4 May 1956, 805

Amino Acid Handbook, R. J. Bleck and K. W. Weiss (Thomas), 12 Apr. 1957, 702

Androgens, R. I. Dorfman and R. A. Shipley (Wiley; Chapman & Hall), 27 Apr. 1956, 738

Bacterial Anatomy, E. T. C. Spooner and B. A. D. Stocker, Eds. (Cambridge Univ. Press), 7 Sept. 1956, 445

Biochemical Preparations, vol. 4, W. W. Westerfeld, Ed. (Wiley; Chapman & Hall), 11 May 1956, 852

Biochemistry and the Central Nervous System, H. McIlwain (Little, Brown), 27 Apr. 1956, 737

The Biochemistry and Physiology of Bone, G. H. Bourne, Ed. (Academic), 8 Mar. 1957, 450

Chemical Methods of Blood Analysis, S. D. Balakhovskii and I. S. Balakhovskii (State Publishing House of Medical Literature, Moscow), 18 May 1956, 899

Currents in Biochemical Research 1956, D. E. Green, Ed. (Interscience), 9 Nov. 1956, 942

Elements d'Immunologie Générale, P. Gastinel, R. Fasquelle, P. Barbier (Masson), 31 Aug. 1956, 412

Enzymes: Units of Biological Structure and Function, O. H. Gaebler, Ed. (Academic), 2 Nov. 1956, 896

Essays in Biochemistry, S. Graff, Ed. (Wiley; Chapman & Hall), 27 July 1956, 184

Fibrous Proteins and Their Biological Significance, No. 9, Society for Experimental Biology (Academic), 18 May 1956, 899

Immunology and Serology, P. L. Carpenter (Saunders), 27 Apr. 1956, 738

Lectures in Immunochemistry, M. Heidelberger (Academic), 15 Mar. 1957, 506

Methods of Biochemical Analysis, vol. 3, D. Glick, Ed. (Interscience), 28 Sept. 1956, 591

Recent and Important McGRAW-HILL *Books*

FOR CLASSROOM, LIBRARY & LABORATORY REFERENCE

* *An All Inclusive Physics Reference Work —*

PHYSICS HANDBOOK

American Institute of Physics

1488 pages, $15.00

THE MAJOR REFERENCE FOR EVERY STUDENT OF PHYSICS

Now, prepared by a number of specialists under the auspices of the American Institute of Physics, comes this valuable reference book to give the scientist and engineer quick access to the data for on-the-job demands. Here are hundreds of facts, drawn from the experience of specialists, classified and indexed for quick use.

Covers all the latest information . . .

In this monumental reference volume, physicists and engineers will find a wide range of tables, graphs, and summaries of formulas in the fields of mathematics, mechanics, heat, sound, electricity and magnetism, optics, atomic and molecular physics, and nuclear physics. Every section is the work of a number of specialists in that field. It contains a selected, annotated bibliography of sources of mathematical tables, and leaves nothing to be desired in the way of technical information.

* *An Outstanding New Series —*

PROGRESS IN NUCLEAR ENERGY

Published by special arrangement with the Pergamon Press, London

Under the consulting editorship of

J. V. DUNWORTH, D.B.E. — D. J. HUGHES

F. PERRIN — A. M. WEINBERG

This new series represents the most complete selection of the latest information and data on nuclear energy available. All articles are written by experts of several countries, based largely on related papers presented at the United Nations Conference on Peaceful Uses of Atomic Energy. They aim to make it easier for scientists and engineers to obtain information outside their special field.

SERIES 1. **PHYSICS AND MATHEMATICS**
Volume I (*Charpie; Horowitz; Hughes; Littler*) 398 pages, $12.00

SERIES 2. **REACTORS**
Volume I (*Charpie; Hughes; Littler; Trocheris*) 420 pages, $14.00

SERIES 3. **PROCESS CHEMISTRY**
Volume I (*Bruce; Fletcher; Hyman; Katz*) 420 pages, $12.00

SERIES 4. **TECHNOLOGY AND ENGINEERING**
Volume I (*Hurst & McLain*) 419 pages, $12.00

SERIES 5. **METALLURGY AND FUELS**
Volume I (*Finniston & Howe*) 808 pages, $21.00

SERIES 6. **BIOLOGICAL SCIENCES**
Volume I (*Bugher; Coursaget; Loutit*) 480 pages, $7.00

SERIES 7. **MEDICAL SCIENCES**
Volume I (*Bugher; Coursaget; Loutit*) 480 pages, $6.00

SERIES 8. **ECONOMICS OF NUCLEAR POWER**
Volume I (*Gueron; Lane; Maxwell; Menke*) 513 pages, $17.00

* **Choose From These Outstanding Science Books**

1. **Ahrens, Rankama & Runcorn**
CHEMISTRY AND PHYSICS OF THE EARTH — $8.00
2. **Beckenbach**
MODERN MATHEMATICS FOR THE ENGINEER — $7.50
3. **Biffin & Seaman**
MODERN INSTRUMENTS IN CHEMICAL ANALYSIS — $7.50
4. **Clifton**
INTRODUCTION TO BACTERIAL PHYSIOLOGY — $8.50
5. **deSitter**
STRUCTURAL GEOLOGY — $11.00
6. **Dixon & Massey**
INTRODUCTION TO STATISTICAL ANALYSIS, 2nd Ed. — $6.00
7. **Ewing, Jardetsky & Press**
ELASTIC WAVES IN LAYERED MEDIA — $10.00
8. **Hill**
STATISTICAL MECHANICS: Principles & Selected Applications — $9.00
9. **Oughterson & Warren**
MEDICAL EFFECTS OF THE ATOMIC BOMB IN JAPAN — $8.00
10. **Petterssen**
WEATHER ANALYSIS AND FORECASTING
Vol. I—Motion and Motion Systems, 2nd Ed. — $8.50
Vol. II—Weather and Weather Systems, 2nd Ed. — $6.00
11. **Robertson**
MODERN CHEMISTRY FOR THE ENGINEER AND SCIENTIST — $9.50
12. **Wallen**
CLINICAL PSYCHOLOGY — $6.00
13. **Zemansky**
HEAT AND THERMODYNAMICS, 4th ed. — $7.50

USE THIS COUPON

College Department
McGRAW-HILL BOOK CO., Inc.
330 West 42nd Street
New York 36, N.Y.

Please send me, on approval, a copy of the books checked (or numbered) below. I agree to pay for the books upon receipt of invoice or return within 10 days.

☐ **PHYSICS HANDBOOK**
☐ **PROGRESS IN NUCLEAR ENERGY**
(indicate series numbers .....)
☐ **OTHER OUTSTANDING TEXTS**
(indicate numbers from 1 to 13 ....)

Name .....
Address .....
City ..... Zone ..... State .....
Title .....
Affiliation S457

Send for copies on approval

McGRAW-HILL BOOK COMPANY, INC.

330 West 42nd Street — New York 36, N. Y.

☐ **ENCYCLOPEDIA OF CHEMISTRY** *edited by Clark and Hawley.* The first complete, multi-author one-volume reference covering a broad spectrum of chemically important subjects. Over 800 articles, 500 contributors, and 1,000 pages of remarkably condensed, authoritative information on modern chemistry from Abrasives through Zirconium. No other single volume offers so much to all workers in chemistry and in the dozen or more sciences that border on it. 1957, $19.50

☐ **ORGANIC CHEMISTRY,** *New 3rd Edition by Louis F. and Mary Fieser.* Now larger, more complete, thoroughly revised and brought up to date. Develops in orderly sequence the principles and concepts of modern organic chemistry and the applications of fundamental science to technology, biochemistry and medicine. Covers latest developments in theory and organic structures. 1956, $10.00

☐ **ORGANIC SYNTHESIS — In Two Volumes,** *by Vartkes Migrdichian.* The most systematic, fully integrated, and up-to-date presentation of organic synthesis in all its aspects ever published! Great emphasis is put on the later advances, the "name" reactions, the olefins and acetylenic compounds, and many others. All standard methods are completely covered. This is a truly monumental work that stands unchallenged in the field.
2 Volumes, 1957, $35.00 (Not sold separately)

☐ **MODERN PULP AND PAPER MAKING,** *edited by John B. Calkin.* Encompasses in a single volume modern equipment, processes, and methods. Included is valuable information on the economics of the industry, on general mill design, and especially on the core of the paper making industry—the machine room. All who need a broad knowledge of pulp or paper technology and manufacturing will be amply rewarded by this useful volume. 1957, $10.00

☐ **BIOLOGICAL TREATMENT OF SEWAGE AND INDUSTRIAL WASTES,** *Volume 1, edited by McCabe and Eckenfelder.* Covering aerobic oxidation, this volume describes the principles of bio-oxidation, the theory of oxygen transfer, and the design and operation of typical sewage and industrial waste treatment processes. 1956, $10.00

☐ **THE CONDENSED CHEMICAL DICTIONARY,** *New 5th Edition edited by Arthur and Elizabeth Rose.* Over 30,000 revised, up-to-date entries; 1,220 double-column pages as compared with 760 pages in the previous edition; more than 6 years in preparation. enormously expanded trade name information obtained directly from producers; thumb-indexed for quick reference; larger, easier-to-read print. 1956, $12.50

☐ **HANDBOOK OF FOOD & AGRICULTURE** *edited by F. C. Blanck.* Over 1,000 pages of expert information on the newest applications of science to the food and agricultural fields! Covers: soils and plant growth; fertilizers; insecticides; growth regulants; essential nutrients; storage of raw products; food processing; preservation; packaging; quality control; waste disposal; and many other important topics. 1955, $15.00

☐ **DRYING & DEHYDRATION OF FOODS,** *New 2nd Edition, by H. W. von Loesecke.* Covers newest advances in methods and equipment for dehydrating all types of fruits, vegetables, meats, fish and dairy products. Describes plant sanitation, waste disposal, nutritional values, packaging, storing and rehydration of dehydrated foods. 1955, $7.50

☐ **CHEMISTRY OF THE SOIL** *Edited by F. E. Bear.* Describes chemical aspects of soils in relation to their development, present constitution, and uses. Covers composition, colloids, organic matter relationships, oxidation-reduction phenomena, nutrient fixation, trace element chemistry, and many other important topics.
ACS Monograph, 1955, $8.75

☐ **PROBLEMS AND CONTROL OF AIR POLLUTION** *by the Committee on Air-Pollution Controls, ASME.* Based on the papers presented at the First International Congress on Air Pollution by the world's foremost authorities in the field. 1955, $7.50

☐ **TEMPERATURE: *Its Measurement and Control in Science and Industry,* Vol. 2** *edited by Hugh C. Wolfe for the American Institute of Physics.* Records the proceedings of the Third International Symposium on Temperature held October 1954. Presents invaluable new material on techniques determining temperatures from .001°K to the core of an atomic explosion. Includes new revisions in the international temperature scale, techniques of resistance thermometry, use of superconductors and semiconductors, temperatures in non-equilibrium situations, optical measurement methods, measurement in engineering, and much, much more. 1955, $12.00

☐ **VEGETABLE FATS AND OILS** *by E. W. Eckey.* Describes all of the most important vegetable fats and oils. Includes latest information on the plant from which each kind of fat is derived, the composition of the fat-bearing part, and the characteristics of the fat itself.
ACS Monograph, 1954, $17.50

FREE EXAMINATION

REINHOLD PUBLISHING CORPORATION
Dept. M-139, 430 Park Ave., New York 22, N. Y.

Please send me the books checked above for 10 days' FREE EXAMINATION.

NAME_____
(Please Print)

ADDRESS_____

Methods in Enzymology, vols. 1 and 2, S. P. Colowick and N. O. Kaplan (Academic), 27 Apr. 1956, 739

Noradrenaline, U. S. von Euler (Thomas), 21 Sept. 1956, 540

Official Methods of Analysis of the Association of Official Agricultural Chemists, W. Horowitz, Ed. (Association of Official Agricultural Chemists), 25 May 1956, 945

Photosynthesis and Related Processes, vol. 2, E. I. Rabinowitch (Interscience), 8 Mar. 1957, 450

Pilot Plant Techniques of Submerged Fermentation (Fondazione Emanuele Paterno; Interscience), 24 Aug. 1956, 369

Polysaccharides in Biology, G. F. Springer, Ed. (Josiah Macy, Jr., Foundation), 19 Oct. 1956, 729

Progress in Neurobiology: 1, Neurochemistry, S. R. Korey and J. I. Nurnberger, Eds. (Hoeber-Harper), 26 Oct. 1956, 827

Protozoologie, K. G. Grell (Springer), 8 Feb. 1957, 237

Recent Progress in Hormone Research, vol. 12, G. Pincus, Ed. (Academic), 22 Feb. 1957, 357

Transport and Accumulation in Biological Systems, E. J. Harris (Academic; Butterworths), 2 Nov. 1956, 895

Vitamins and Hormones, vol. 14, R. S. Harris, G. F. Marrian, K. V. Thimann (Academic), 22 Feb. 1957, 357

Botanical Sciences

Agricultural Ecology, G. Azzi (Constable), 23 Nov. 1956, 1034

Chromosome Botany, C. D. Darlington (Allen & Unwin), 12 Oct. 1956, 688

Common Exotic Trees of South Florida (Dicotyledons), M. F. Barrett (Univ. of Florida Press), 15 Mar. 1957, 505

Features of Evolution in the Flowering Plants, R. Good (Longmans, Green), 8 Feb. 1957, 239

Grasslands of the Great Plains, J. E. Weaver, F. W. Albertson, B. W. Allred, A. Heerwagen (Johnson), 7 Sept. 1956, 444

A Handbook of Hardwoods, Forest Products Research Laboratory (H. M. Stationery Office), 14 Dec. 1956, 1212

The History of the British Flora, H. Godwin (Cambridge Univ. Press), 30 Nov. 1956, 1084

New Concepts in Flowering-Plant Taxonomy, J. Heslop-Harrison (Harvard Univ. Press), 7 Dec. 1956, 1153

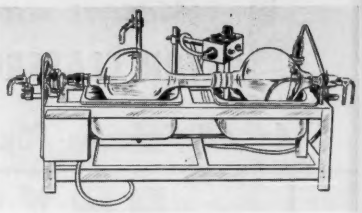
Principles and Practice of Field Experimentation, J. Wishart and H. G. Sanders (Commonwealth Bureau of Plant Breeding and Genetics, Cambridge, England), 10 Aug. 1956, 280

Chemistry

Advances in Carbohydrate Chemistry, M. L. Wolfrom and R. S. Tipson, Eds. (Academic), vol. 2, 8 Feb. 1957, 238; vol. 10, 22 June 1956, 1134

Advances in Catalysis and Related Subjects, vol. 7, W. G. Frankenburg, V. I. Komarewsky, E. K. Rideal, Eds. (Academic), 14 Sept. 1956, 494

Bibliography of Solid Adsorbents, 1943–1953, V. R. Deitz (National Bureau of Standards), 19 Oct. 1956, 729



FLASH EVAPORATOR
Continuous Model No. FE-2C

Evaporates under reduced pressure—particularly valuable when aqueous solutions and high boiling solvents (e.g., butanol) are used.

- Ideal for separation of :
  Concentrated solutions that would otherwise foam
  Heat and air sensitive solutions
- Performs separations in a fraction of the time required by conventional methods
- Easily disassembled to remove solute and also for cleaning

PRICE COMPLETE
(without Thermo Regulator)

$278.30 F.O.B. New York

Also available: FLASH EVAPORATOR FE-2. Regular model for single batches.

Price complete $215.50 F.O.B. New York

Write for other laboratory specialities and detailed information on the **PROPIPETTE,** *SAFETY PIPETTE FILLER*

INSTRUMENTATION ASSOCIATES
17 West 60th Street, New York 23, N.Y.

PSYCHOPHARMACOLOGY
AAAS Symposium Volume
edited by
Nathan S. Kline

6" x 9", clothbound, 175 pp., bibliographies, index, 1956
$3.50 ($3.00 for cash orders by AAAS members)

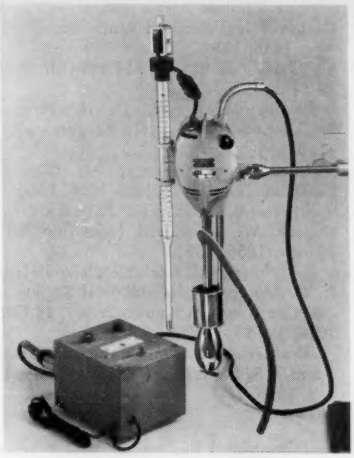
This volume consists of material presented at the first major conference on the remarkably successful use of new drugs such as chlorpromazine in the treatment of mental disease.

"The authors are competent and careful workers who have approached this problem with a scientific attitude . . . Throughout the volume runs the thread of caution . . . New vistas are being opened for the psychiatrist, the neurologist, the physiologist, the psychologist, the pharmacologist and the chemist." Foreword. Winfred Overholser.

"This volume is not a reference intended for use at the introductory student level. It can be reviewed with interest, however, by any serious member of the reading public." *American Journal of Pharmaceutical Education,* July 1956.

At all book stores or write

American Association for the Advancement of Science
1515 Massachusetts Ave., NW
Washington 5, D.C.



Water or Oil Bath Heating — Circulation Temperature Control in ONE compact unit

BRONWILL®
Constant Temperature
CIRCULATOR
(Pat. Pending)

- **CONVERTS** any suitable container into a constant temperature bath.
- **WILL CIRCULATE** tempered fluid with controlled flow.
- **NEW** long-life, quiet motor — 4500 RPM.
- **CONTACT THERMOMETER.** Magnetic setting 0 - 100° C.
- **TEMPERATURE** sensitivity ± 0.01° C in insulated bath.

A COMPLETE PORTABLE UNIT ONLY 20" HIGH FOR HEATING, CIRCULATION AND TEMPERATURE CONTROL

Write Dept. S-47 for full details.

BRONWILL
SCIENTIFIC DIVISION
WILL CORPORATION
131 GOULD ST. ROCHESTER 10, N. Y.
DEALERS: Will Corporation • Harshaw Scientific • Chicago Apparatus • Braun-Knecht-Heiman • Canlab

Chemistry of Carbon Compounds, vol. 3, E. H. Rodd, Ed. (Elsevier), 14 Dec. 1056, 1215

The Chemistry of the Coordination Compounds, J. C. Bailar, Jr., Ed. (Reinhold; Chapman & Hall), 23 Nov. 1956, 1033

Comprehensive Inorganic Chemistry, vol. 4, M. C. Sneed and R. C. Brasted, Eds.; H. M. Cyr and T. D. O'Brien (Van Nostrand), 25 May 1956, 944

Determination of Organic Compounds, K. G. Stone (McGraw-Hill), 21 Dec. 1956, 1255

Gmelins Handbuch der Anorganischen Chemie, Gmelin Institute, Ed. (Verlag Chemie, ed. 8), System No. 28, *Calcium*, pt. B, sec. 1, 2 Nov. 1956, 896; System No. 60, *Copper*, pt. A, secs. 1 and 2, 5 Oct. 1956, 633; vol. 44, *Thorium and Isotopes*, 14 Sept. 1956, 494

Nouveau Traité de Chimie Minérale (Masson), vol. 1, G. Bouissières, M. Haïsinsky, G. Pannetier, P. Pascal, R. Villard; vol. 10, P. Pascal and R. Dubrisay, Eds., 1 Mar. 1957, 401

Physical Chemistry, F. Daniels and R. A. Alberty (Wiley; Chapman & Hall), 27 Apr. 1956, 737

Physical Methods in Chemical Analysis, vol. 3, W. G. Berl, Ed. (Academic), 5 Apr. 1957, 653

Progress in the Chemistry of Organic Natural Products, vol. 12, L. Zechmeister, Ed. (Springer), 18 May 1956, 898

Progress in Organic Chemistry, vol. 3, J. W. Cook, Ed. (Academic; Butterworths), 25 May 1956, 945

Resonance in Organic Chemistry, G. W. Wheland (Wiley; Chapman & Hall), 6 July 1956, 35

Semimicro Qualitative Analysis, F. J. Welcher and R. B. Hahn (Van Nostrand), 11 May 1956, 852

Steric Effects in Organic Chemistry, M. S. Newman, Ed. (Wiley; Chapman & Hall), 15 Mar. 1957, 504

Structure Reports for 1942–1944, vol. 9, A. J. C. Wilson, N. C. Baenziger, J. M. Bijvoet, J. M. Robertson, Eds. (Published for the International Union of Crystallography, Oosthock's Uitgevers MIJ), 17 Aug. 1956, 325

The Systematic Identification of Organic Compounds, R. L. Shriner, R. C. Fuson, D. Y. Curtin (Wiley; Chapman & Hall), 3 Aug. 1956, 232

Treatise on Inorganic Chemistry, vol. 2, H. Remy; J. Kleinberg, Ed. (Elsevier), 4 Jan. 1957, 27

Valency and Molecular Structure, E. Cartmell and G. W. A. Fowles (Academic; Butterworths), 14 Dec. 1956, 1213

Earth Sciences

Advances in Geophysics, vol. 2, H. E. Landsberg, Ed. (Academic), 15 June 1956, 1085

Antarctica in the International Geophysical Year, U.S. National Committee for the IGY; NSF; American Geophysical Union (American Geophysical Union), 28 Dec. 1956, 1297

Arctic Research, D. Rowley, Ed. (Arctic Institute of North America), 18 May 1956, 900

Clays and Clay Minerals, A. Swineford

New
ACADEMIC PRESS Publications

Jets, Wakes, and Cavities
By G. BIRKHOFF and E. H. ZARANTONELLO
March 1957, 353 pp., illus., $10.00

The Physiology of Fishes
Edited by MARGARET E. BROWN
Volume 1. METABOLISM
April 1957, 447 pp., 91 figs., $12.00
Volume 2. BEHAVIOR
May 1957, about 500 pp., illus., approx. $12.50
Ten per cent price reduction for complete set

Methods in Enzymology
Edited by S. P. COLOWICK and N. O. KAPLAN
Volume III
January 1957, 1,154 pp., illus., $26.00

Hormones, Brain Function, and Behavior
Edited by H. HOAGLAND
March 1957, 257 pp., illus., $7.00

Quantum Chemistry
AN INTRODUCTION
By WALTER KAUZMANN
January 1957, 744 pp., illus., $12.00

Some Principles of Energetics in Biochemical Reactions
By I. M. KLOTZ
April 1957, 64 pp., illus., $3.00

Biochemistry of the Amino Acids
By A. MEISTER
April 1957, 481 pp., illus., $10.00

The Leukemias: Etiology, Pathophysiology, and Treatment
Edited by J. REBUCK, F. BETHELL, and R. MONTO
April 1957, 711 pp., illus., $13.00

Drug Resistance of Microorganisms
By R. J. SCHNITZER and E. GRUNBERG
April 1957, 395 pp., illus., $10.00

Biochemical Disorders in Human Disease
Edited by R. H. S. THOMPSON and E. J. KING
Spring 1957, about 800 pp., illus., $12.60

The Fundamentals of Electric Log Interpretation
SECOND EDITION, revised and reset
By M. R. J. WYLLIE
March 1957, 176 pp., illus., $4.50

Advances in Geophysics. Vol. 3
Edited by H. E. LANDSBERG
February 1957, 378 pp., illus., $8.80

Canadian Cancer Conference Vol. 2
Edited by R. W. BEGG
March 1957, 398 pp., illus., $8.50

The Harvey Lectures. Series 51
February 1957, 298 pp., illus., $7.50

Special leaflets available upon request

ACADEMIC PRESS Inc.
111 Fifth Avenue, New York 3, N. Y.

and N. Plummer, Eds. (National Academy of Sciences–National Research Council), 11 May 1956, 851

L'Evolution de la Lithosphere. I, Pétrogenèse, H. Termier and G. Termier (Masson), 3 Aug. 1956, 231

Exploration for Nuclear Raw Materials, R. D. Nininger, Ed. (Van Nostrand), 4 Jan. 1957, 28

Floods, W. G. Hoyt and W. B. Langbein (Princeton Univ. Press), 28 Sept. 1956, 591

Fluid Models in Geophysics, R. R. Long, Ed. (Office of Naval Research, Geophysics Research Directorate, U.S. Weather Bureau, Government Printing Office), 14 Sept. 1956, 493

The Future of Arid Lands, G. F. White, Ed. (American Association for the Advancement of Science), 29 Mar. 1957, 606

La Genese des Sols en tant que Phénomène Géologique, H. Erhart (Masson), 8 June 1956, 1044

Geology and Ourselves, F. H. Edmunds (Philosophical Library), 11 Jan. 1957, 78

Handbook of South American Geology, W. F. Jenks, Ed. (Geological Society of America), 23 Nov. 1956, 1031

Jurassic Geology of the World, W. J. Arkell (Hafner), 30 Nov. 1956, 1086

Man's Role in Changing the Face of the Earth, W. L. Thomas, Jr., Ed. (Univ. of Chicago Press), 18 Jan. 1957, 123

New Zealand Geomorphology, C. A. Cotton (New Zealand Univ. Press), 27 Apr. 1956, 736

Précis de Géologie, L. Moret (Masson), 28 Sept. 1956, 592

Realms of Water, P. H. Kuenen (Wiley; Cleaver-Hume), 22 June 1956, 1135

Stratigraphic Geology, M. Gignoux (Freeman, ed. 4), 29 June 1956, 1180

Structural Geology for Petroleum Geologists, W. L. Russell (McGraw-Hill), 27 Apr. 1956, 735

Treatise on Invertebrate Paleontology, R. C. Moore, Ed. (Geological Society of America; Univ. of Kansas Press), 14 Dec. 1956, 1213

Weather Analysis and Forecasting, vols. 1 and 2, S. Petterssen (McGraw-Hill), 19 Oct. 1956, 728

History and Philosophy of Science

Archimedes, vol. 12, E. J. Dijksterhuis (Munksgaard), 12 Apr. 1957, 702

Atomic Quest, A. H. Compton (Oxford Univ. Press), 7 Dec. 1956, 1152

Atom und Psyche, E. F. von Eickstedt (Enke), 22 June 1956, 1135

Beiträge zur Geschichte der Erkenntnis des Erdmagnetismus, H. Balmer (Sauerländer), 22 Feb. 1957, 356

Biographical Memoirs of Fellows of the Royal Society, vol. 1 (Royal Society of London), 27 Apr. 1956, 730

The Biology of the Spirit, E. W. Sinnott (Viking), 27 Apr. 1956, 729

E. A. Birge, a Memoir, G. C. Sellery and C. H. Mortimer (Univ. of Wisconsin Press), 19 Oct. 1956, 728

Ludwig Boltzmann, Mensch, Physiker, Philosoph, E. Broda (Deuticke), 27 Apr. 1956, 732

The Crime of Galileo, G. de Santillana (Univ. of Chicago Press), 29 June 1956, 1180

Die Selbstgestaltung des Lebendigen, K. Friederichs (Reinhardt), 22 June 1956, 1135

Engineering in History, R. S. Kirby, S. Withington, A. B. Darling, F. G. Kilgour (McGraw-Hill), 24 Aug. 1956, 370

Evolution: the Ages and Tomorrow, G. M. McKinley (Ronald), 4 Jan. 1957, 27

History of American Technology, J. W. Oliver (Ronald), 24 Aug. 1956, 370

Imagination's Other Place, H. Plotz, Compiler (Crowell), 27 Apr. 1956, 730

Language, Thought, and Reality, B. L. Whorf and J. B. Carroll, Eds. (Technology Press; Wiley; Chapman & Hall), 27 Apr. 1956, 730

Life, the Great Adventure, J. Rostand and P. Bodin (Scribner), 31 Aug. 1956, 410

Microscopium, M. Rooseboom (National Museum for the History of Science), 21 Dec. 1956, 1254

Physics, Psychology and Medicine, J. H. Woodger (Cambridge Univ. Press), 4 Feb. 1957, 237

Portraits from Memory, R. B. Goldschmidt (Univ. of Washington Press), 22 Mar. 1957, 557

The Pursuit of Science in Revolutionary America, 1735–1789, B. Hindle (Univ. of North Carolina Press), 21 Sept. 1956, 542

Reflections of a Physicist, P. W. Bridg-

PACKARD

AUTOMATIC

FRACTION COLLECTORS

for Column Chromatography

Time, Drop Counting and Special Types

1 Packard Automatic Fraction Collectors provide extremely precise volume measurement and ease of operation.

2 Their reputation for excellent performance is backed by years of continuous service in laboratories throughout the nation.

3 Simple mechanical and electronic design results not only in high reliability but also in initial cost economy.

4 Sample hold-up, mixing and possibility of contamination are all eliminated in standard time and drop counting models. There are no intermediate vessels, glass arms or funnels. Drops from the column fall directly into the test tubes.

5 Special turntables, large preparative fraction collectors and various volumetric measuring and continuous monitoring devices are available.

For complete information send card or letter requesting illustrated 4-page Bulletin 230.

Packard Instrument Company

DEPT. A • P. O. BOX 428 • LA GRANGE, ILLINOIS

OPTICAL CRYSTALS

WINDOWS

LENS ELEMENTS

PRISMS

Write for Technical Bulletin 157A

Let us show you how our *disposable window plan* can provide you with high quality finished windows for optical cells at low cost.

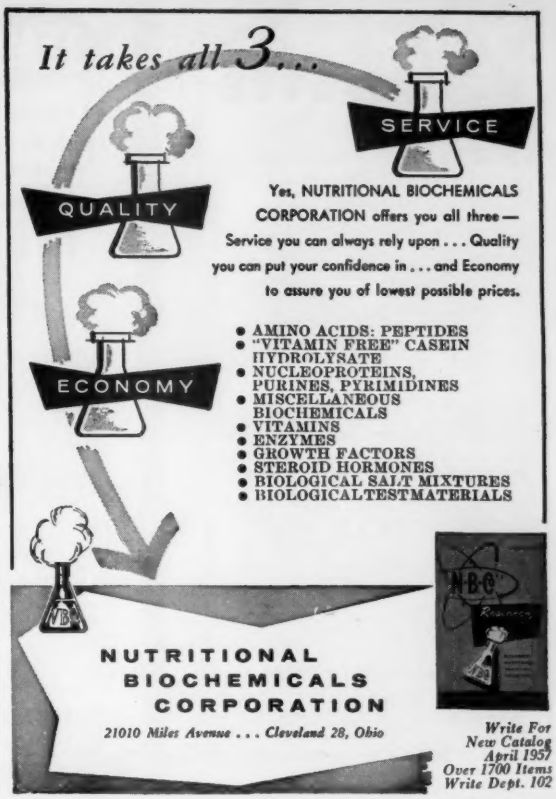
SCINTILLATION CRYSTALS

NaI(Tl), KI(Tl), LiI(Eu), ^{6}LiI(Eu), CsI(Tl), Anthracene, Stilbene, Plastic scintillators. Available unmounted or mounted and hermetically sealed.

Write for Technical Bulletins 257A, 357A

ISOMET CORPORATION

P.O. Box 34 **Palisades Park, New Jersey**


It takes all 3...
SERVICE
QUALITY
ECONOMY
Yes, NUTRITIONAL BIOCHEMICALS CORPORATION offers you all three — Service you can always rely upon . . . Quality you can put your confidence in . . . and Economy to assure you of lowest possible prices.
• AMINO ACIDS: PEPTIDES
• "VITAMIN FREE" CASEIN HYDROLYSATE
• NUCLEOPROTEINS, PURINES, PYRIMIDINES
• MISCELLANEOUS BIOCHEMICALS
• VITAMINS
• ENZYMES
• GROWTH FACTORS
• STEROID HORMONES
• BIOLOGICAL SALT MIXTURES
• BIOLOGICAL TEST MATERIALS
NBC
NUTRITIONAL BIOCHEMICALS CORPORATION
21010 Miles Avenue . . . Cleveland 28, Ohio
Write For New Catalog April 1957 Over 1700 Items Write Dept. 102

The Infectious Diseases of Domestic Animals

WITH SPECIAL REFERENCE TO ETIOLOGY, DIAGNOSIS, AND BIOLOGIC THERAPY. 3RD EDITION.

By William Arthur Hagan, D.V.M., D.Sc., Professor of Veterinary Bacteriology and Dean of the Faculty, New York State Veterinary College, and Dorsey William Bruner, D.V.M., Ph.D., Professor of Bacteriology, New York State Veterinary College, Cornell University

Extensively revised, modernized, and enlarged, this is a new edition of a standard book which is now being used both as a text in veterinary schools across the country and as a reference by practitioners, students, and research workers.

This third edition, in keeping with the attempt to provide as complete and up-to-date coverage on the subject as possible, contains not only extensive revisions, but two additional chapters. The first considers the Eumycetes; the second, infectious diseases of unknown or uncertain etiology, including discussions on the mucosal disease of cattle, infectious or epizootic infertility of cattle, scrapie, atrophic rhinitis of swine, edema disease of swine, and cat scratch disease.

"A ready reference for the busy practitioner, the laboratory technician, and the research worker. Facts, rather than theories, are the authors' goal."—*Journal of the American Veterinary Medical Association*

992 pages, (approx.), frontis., 171 illus., tables, $10.50

Hydrides of Boron and Silicon

By Alfred Stock

Out of print for several years, this basic work by a world-recognized authority has been reissued to fill a need expressed by chemists now engaged in research in this field. Chemists in colleges, universities, industry, and research laboratories will want to add this important work to their professional libraries.

256 pages, illus., $4.50

Cornell University Press 124 ROBERTS PLACE, *Ithaca, New York*

Now in Use
in Thousands of Labs!

PROPIPETTE

The safe accurate Pipette Filler for Isotopes, Cyanides, Acids, Bacteria and Other Dangerous Solutions

This amazing new instrument is now standard equipment in government, medical and industrial laboratories throughout the nation. Offers more precise measurement (to 0.01 cc), more complete control, and avoids all the risks of mouth pipetting. Holds set level indefinitely, fits any pipette, operates easily with one hand. Order a supply of PROPIPETTES now,

$6.90 each

INSTRUMENTATION ASSOCIATES
17 West 60th Street, New York 23, N.Y.
Dept. S-456

Send for current list of new scientific instruments

TEMCO ®

an entirely new type flask heater with unmatched versatility

Several different flask sizes can be used in this one unit

An improved flask heater with Monel mesh baskets that perfectly "nest" flasks and let you use several sizes in same unit! Uniform heat radiation . . . well-ventilated . . . stainless steel and aluminum double-case construction. No fabrics to become shoddy, saturated, or worn. Stepless controller available for extremely close control. Two models of heater for all popular flask sizes: $22.50 and $34.50. Write for data and name of nearest dealer.

THERMO ELECTRIC MFG. CO.
568 Huff St., Dubuque, Iowa

TABLES OF THE NON-CENTRAL t-DISTRIBUTION: Density Function, Cumulative Distribution Function, and Percentage Points

George J. Resnikoff and Gerald J. Lieberman. The tables are designed to facilitate their use in industrial applications such as quality control and industrial statistics. $12.50

SELECTED PAPERS IN STATISTICS AND PROBABILITY

Abraham Wald. A new printing of the work of one of the giant figures in the field of mathematical statistics. $10.00

SPHEROIDAL WAVE FUNCTIONS

Carson Flammer. A detailed, up-to-date treatment of the analytical properties of the functions, with tables of numerical values. $8.50

1957 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE: Preprints of Papers

The latest technical and scientific advances. Prob. $8.50

DECISION MAKING: An Experimental Approach

Donald Davidson and Patrick Suppes. In collaboration with Sidney Siegel. The theory of rational choice is brought into closer relationship with experimentally feasible situations. $3.25

STANFORD UNIVERSITY PRESS
Stanford, California

man (Philosophical Library), 1 June 1956, 994

Science and Christian Belief, C. A. Coulson (Univ. of North Carolina Press), 27 Apr. 1956, 731

Science and Civilisation in China, vol. 2, J. Needham (Cambridge Univ. Press), 5 Oct. 1956, 631

Stormy Life, E. Heinkel and J. Thorwald, Eds. (Dutton), 1 Mar. 1957, 401

What Is Science? J. R. Newman, Ed. (Simon and Schuster), 27 Apr. 1956, 729

Mathematics

Automata Studies, C. E. Shannon and H. McCarthy (Princeton Univ. Press), 14 Sept. 1956, 493

Automatic Digital Calculators, A. D. Booth and K. H. V. Booth (Academic; Butterworths), 22 Feb. 1957, 355

Einführung in die Geometric der Waben, vol. 4, W. Blaschke (Birkhäuser), 13 July 1956, 83

Engineering Mathematics, K. S. Miller (Rinehart), 18 Jan. 1957, 124

Faster, Faster, W. J. Eckert and R. Jones (McGraw-Hill), 9 Nov. 1956, 943

Fundamental Concepts of Higher Algebra, A. A. Albert (Univ. of Chicago Press), 28 Dec. 1956, 1296

Handbuch der Laplace-Transformation, vol. 2, pt. 1, G. Doetsch (Birkhäuser), 14 Sept. 1956, 490

Introduction to Electronic Analogue Computers, C. A. A. Wass (McGraw-Hill; Pergamon), 2 Nov. 1956, 895

Introduction to Mathematical Logic, vol. 1, A. Church (Princeton Univ. Press), 14 Dec. 1956, 1215

Linear Feedback Analysis, J. G. Thomason (McGraw-Hill; Pergamon), 10 Aug. 1956, 279

Numerical Analysis, Z. Kopal (Wiley), 17 Aug. 1956, 324

Numerical Analysis, vol. 6, J. H. Curtiss, Ed. (McGraw-Hill), 14 Dec. 1956, 1211

Science and Information Theory, L. Brillouin (Academic), 14 Sept. 1956, 492

Topics in Number Theory, vols. 1 and 2, W. J. LeVeque (Addison-Wesley), 28 Dec. 1956, 1297

Topological Dynamics, vol. 36, W. H. Gottschalf and G. A. Hedlund (American Mathematical Society), 14 Sept. 1956, 491

The World of Mathematics, J. R. Newman (Simon and Schuster), 1 Feb. 1957, 197

Medicine

Advances in Veterinary Science, vol. 2, C. A. Brandly and E. L. Jungherr (Academic), 8 June 1956, 1042

Alcoholism as a Medical Problem, H. D. Kruse, Ed. (Hoeber-Harper), 26 Oct. 1956, 828

S. P. Botkin and the Neurogenic Theory of Medicine, L. R. Borodulin (State Publishing House of Medical Literature, Moscow), 11 Jan. 1957, 75

Cancer of the Lung, M. B. Rosenblatt and J. R. Lisa (Oxford Univ. Press), 8 June 1956, 1043

Clinical Electrocardiography, pt. 1, L. N. Katz and A. Pick (Lea and Febiger), 31 Aug. 1956, 411

Color Atlas of Oral Pathology, U.S.

Naval Dental School (Lippincott), 30 Nov. 1956, 1084

Cryptococcosis, M. L. Littman and L. E. Zimmerman (Grune & Stratton), 9 Nov. 1956, 943

Dermatology, D. M. Pillsbury, W. B. Shelley, A. M. Kligman (Saunders), 4 Jan. 1957, 27

Diseases of the Skin, R. L. Sutton, Jr. (Mosby), 22 Feb. 1957, 355

Educating Spastic Children, F. E. Schonell (Philosophical Library), 11 Jan. 1957, 78

Ergebnisse der Medizinischen Grundlagenforschung, K. Fr. Bauer (Thieme), 1 June 1956, 995

Essentials of Biological and Medical Physics, R. W. Stacy, D. T. Williams, R. E. Worden, R. O. McMorris (McGraw-Hill), 15 June 1956, 1086

Glaucoma, F. W. Newell, Ed. (Josiah Macy, Jr., Foundation), 8 Feb. 1957, 238

Guide Pratique de Mycologie Médicale, J. Coudert (Masson), 8 June 1956, 1043

A Handbook for the Identification of Insects of Medical Importance, J. Smart (British Museum of Natural History), 31 Aug. 1956, 411

Handbook of Vital Statistics Methods, Series F, No. 7, *Studies in Methods* (United Nations), 27 Apr. 1956, 747

Inhaltsstoffe und Prüfungsmethoden Homöopathisch Verwendeter Heilpflanzen, H. Schindler (Editio Cantor), 25 Jan. 1957, 163

Lehrbuch und Atlas der Anatomie des Menschen, vol. 1, Rauber-Kopsch (Thieme), 25 May 1956, 945

Medical Effects of the Atomic Bomb in Japan, A. W. Oughterson and S. Warren, Eds. (McGraw-Hill), 15 Mar. 1957, 504

Medical Research: a Midcentury Survey, vols. 1 and 2 (American Foundation), 27 Apr. 1956, 744

Medicinal Chemistry, vol. 2, F. F. Blicke and C. M. Suter, Eds. (Wiley; Chapman & Hall), 12 Oct. 1956, 689

The Menninger Story, W. Winslow (Doubleday), 1 Feb. 1957, 199

The Nature of Brucellosis, W. W. Spink (Univ. of Minnesota Press), 1 Feb. 1957, 197

Observations on Krebiozen in the Management of Cancer, A. C. Ivy, J. F. Pick, W. F. P. Phillips (Regnery), 1 Feb. 1957, 198

Poliomyelitis, International Poliomyelitis Congress (Lippincott), 4 May 1956, 806

Précis de gérontologie, L. Binet and F. Bourlière (Masson), 13 July 1956, 83

Preventive Medicine in World War II, vol. 3, E. C. Hoff, Ed. (Office of Surgeon General, Dept. of the Army), 25 May 1956, 946

Problems in Amoebiasis, C. W. Rees (Thomas), 6 July 1956, 36

Proceedings of the Conference on Pathophysiologic and Therapeutic Problems of Terminal Conditions Associated with the Clinic and Practice of First Aid (State Publishing House of Medical Literature), 5 Oct. 1956, 633

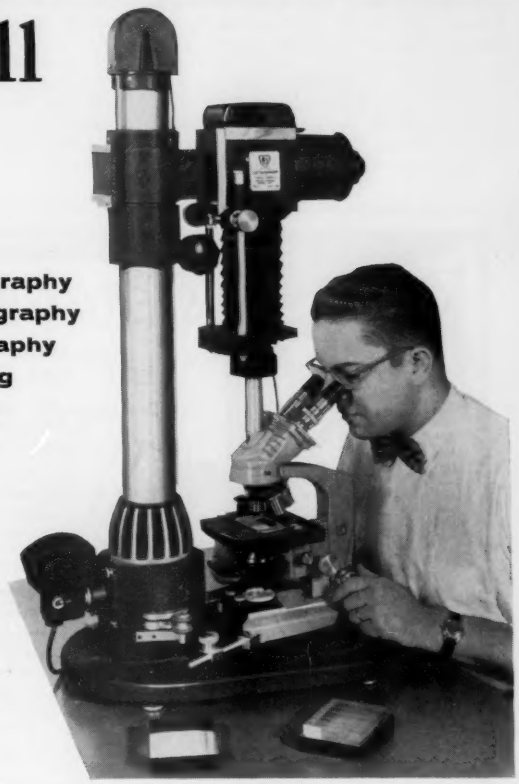
Sites of Infection, A. Mozley (Lewis), 27 July 1956, 184

Some Protozoan Diseases of Man and Animals: Anaplasmosis, Babesiosis, and Toxoplasmosis, vol. 64 (New York Academy of Science), 12 Apr. 1957, 701

ORDER YOUR *Orthophot*

UNIVERSAL PHOTOGRAPHIC CAMERA

from Will



for
Photomicrography
Photomacrography
Cinemicrography
Photocopying
or Enlarging

offers

- **Integral Ortho Illuminator** Precise 10-step control of intensity
- **Compact, rigid stand** Wide variety of interchangeable accessories
- **Precision Reflex Camera**
  Built-in "SPLIT-MICRON" telescope for positive focusing
- **Uses black and white, color film**—No. 120 roll film 2¼″ x 2¼″, cut and pack film 2¼″ x 3¼″, 35 mm film

21721 T — Orthophot Photomicrographic Camera complete (without microscope) for 115 volts A.C. **$1,150.00**

21723 T — 35mm Roll Film Attachment **120.00**

Large selection of low power accessories available.

32-page brochure sent on request.

Order from your nearest Will Supply and Service Center.

Will CORPORATION
and subsidiaries

Specialists in WILL *Scientific Supply*

ROCHESTER 3, N.Y. • ATLANTA 1, GA. • NEW YORK 12, N.Y. • BALTIMORE 24, MD. • BUFFALO 5, N.Y.
SO. CHARLESTON 3, W. VIRGINIA

Therapeutic Use of Artificial Radioisotopes, P. F. Hahn, Ed. (Wiley; Chapman & Hall), 8 Mar. 1957, 449

Traité de Pharmacie Chimique, vols. 1, 2, 3, 4, 5, P. Le Beau and M.-M. Janot, Eds. (Masson; Stechert-Hafner), 14 Dec. 1956, 1212

Wire Brush Surgery, J. W. Burks, Jr. (Thomas), 29 Mar. 1957, 605

Yellow Fever Vaccination, World Health Organization (Columbia Univ. Press), 24 Aug. 1956, 370

Physics

Advances in Electronics and Electron Physics, vol. 7, L. Marton, Ed. (Academic), 17 Aug. 1956, 325

Applications of Spinor Invariants in Atomic Physics, H. C. Brinkman (North Holland; Interscience), 29 June 1956, 1181

Atomic Power, Editors of *Scientific American* (Simon and Schuster), 27 Apr. 1956, 729

Atoms and Energy, H. W. S. Massey (Philosophical Library), 14 Sept. 1956, 493

Cours de Physique Générale. Electricité, G. Goudet (Masson), 11 Jan. 1957, 77

Currents, Fields, and Particles, F. Bitter (Technology Press; Wiley; Chapman & Hall), 14 Dec. 1956, 1211

Dielectric Behavior and Structure, C. P. Smyth (McGraw-Hill), 18 May 1956, 899

STEROX-O-MATIC
GAS STERILIZATION
SAFE • FAST • EFFICIENT
Development of the Castle Sterox-O-Matic Gas Sterilizer introduces an entirely new concept of hospital aseptic routine.
Heat and moisture-sensitive supplies too delicate for conventional processing may now be Steroxcide sterilized in the hospital countless times without injury. Substantial savings in sterile supply costs will result.
Adhesives, cystoscopes, catheters, eye instruments, powdered goods ... even electric cords may now be sealed, processed and distributed in paper or plastic containers.
Newly developed water ejection unit speeds cycle, prepares spore-bearing organisms for killing action of gas.
Pre-packaged materials may be processed and distributed in their own containers for indefinite sterile storage.
For additional information write for Catalog Section 4 (T).
Castle
WILMOT CASTLE COMPANY
1713C East Henrietta Road • Rochester, N. Y.
LIGHTS AND STERILIZERS

Les Dislocations et la Croissance des Cristaux, W. Dekeyser and S. Amelinckx (Masson), 27 July 1956, 183

Electricité, Y. Rocard (Masson), 4 Jan. 1957, 28

Electrochemical Affinity, P. Van Rysselberghe (Hermann), 14 Dec. 1956, 1214

Electronic Transformers and Circuits, R. Lee (Wiley; Chapman & Hall), 27 Apr. 1956, 733

Eléments de Mécanique Quantique, Ph. Pluvinage (Masson), 9 Nov. 1956, 943

Flow of Gases through Porous Media, P. C. Carman (Academic; Butterworths), 21 Dec. 1956, 1254

Geometrical Optics, L. C. Martin (Philosophical Library), 3 Aug. 1956, 231

Handbuch der Physik, S. Flügge, Ed. (Springer), vol. 1, *Mathematical Methods,* 14 Dec. 1956, 1214; vol. 14, *Low Temperature Physics I,* 9 Nov. 1956, 942; vol. 15, *Low Temperature Physics II,* 12 Apr. 1957, 701; vol. 19, *Electrical Conductivity I,* 23 Nov. 1956, 1032; vol. 36, *Atom II,* 25 Jan. 1957, 162; vol. 47, *Geophysics,* 26 Oct. 1956, 829

High Energy Nuclear Physics, Proceedings of the Sixth Annual Rochester Conference, 3–7 Apr. 1956, J. Ballam, V. L. Fitch, T. Fulton, K. Huang, R. R. Rau, S. B. Treiman, Eds. (Interscience), 28 Dec. 1956, 1298

The International Dictionary of Physics and Electronics, W. C. Michels, Ed. (Van Nostrand; Macmillan), 19 Oct. 1956, 728

An Introduction to Reactor Physics, D. J. Littler and J. F. Raffle (McGraw-Hill; Pergamon), 27 Apr. 1956, 734

Kernmomente, H. Kopfermann (Akademische Verlagsgesellschaft), 7 Dec. 1956, 1152

Lectures on Theoretical Physics, vol. 5, A. Sommerfeld, F. Bopp, J. Meixner, Eds. (Academic), 13 July 1956, 84

The Meaning of Relativity, A. Einstein (Princeton Univ. Press), 3 Aug. 1956, 230

Mesons and Fields, vol. 1, S. S. Schweber, H. A. Bethe, F. De Hoffmann (Row, Peterson), 27 Apr. 1956, 733

Modern Physics, J. C. Slater, McGraw-Hill), 4 May 1956, 805

Nuclear Radiation Detectors, J. Sharpe (Methuen; Wiley), 29 June 1956, 1181

Photoconductivity Conference, R. G. Breckenridge, Chairman, Editorial Committee (Wiley; Chapman & Hall), 15 Mar. 1957, 505

Physics, J. S. Marshall and E. R. Pounder (Macmillan), 5 Apr. 1957, 654

Physics of Fully Ionized Gases, L. Spitzer, Jr. (Interscience), 6 July 1956, 35

Physics and Mathematics, R. A. Charpie, J. Horowitz, D. J. Hughes, D. J. Littler, Eds. (McGraw-Hill; Pergamon), 26 Oct. 1956, 827

Principles and Problems in Energetics, J. N. Brønsted (Interscience), 27 Apr. 1956, 733

Progress in Cosmic Ray Physics, vol. 3, J. G. Wilson, Ed. (North Holland; Interscience), 22 Feb. 1957, 356

Rayonnements de Particules Atomiques, Electrons et Photons, A. Berthelot (Masson), 4 Jan. 1957, 29

Reactor Shielding Design Manual, T. Rockwell III, Ed. (Van Nostrand), 28 Sept. 1956, 591

Relativity: the Special Theory, J. L.

New Titles in
The Cambridge Monographs on Experimental Biology

•

THE PHYSIOLOGY OF REPRODUCTION IN FUNGI

by LILIAN E. HAWKER, D. Sc.

This book surveys the available information on the physiology of reproduction in fungi and suggests directions in which further work is desirable. $3.00

•

THE WATER RELATIONS OF TERRESTRIAL ARTHROPODS

by E. B. EDNEY, D. Sc.

Because they are so small, the water economy of insects, spiders and other smaller groups is of great significance. This book is an enquiry into the various processes of water-uptake, the sources of water-loss, and the means by which a balance is achieved. $3.00

Both are available through your book dealer

CAMBRIDGE UNIVERSITY PRESS
32 East 57th Street, New York 22, N. Y.

The Latest

ANNUAL REVIEWS

PSYCHOLOGY Vol. 8 (Jan. 57)	PLANT PHYSIOLOGY Vol. 7 (June 56)
ENTOMOLOGY Vol. 2 (Feb. 57)	BIOCHEMISTRY Vol. 25 (July 56)
PHYSIOLOGY Vol. 19 (March 57)	PHYSICAL CHEMISTRY Vol. 7 (Sept. 56)
MEDICINE Vol. 8 (May 57)	MICROBIOLOGY Vol. 10 (Oct. 56)

NUCLEAR SCIENCE
Vol. 6 (Dec. 56)

Most Back Volumes also available

$7.00 postpaid (U.S.A.); $7.50 postpaid (elsewhere)

ANNUAL REVIEWS, INC.

Grant Avenue, Palo Alto, California

jmj

JOSIAH MACY, JR. FOUNDATION

Announces three new books

COLD INJURY

Transactions of the Fourth Conference. *Edited by M. Irené Ferrer, College of Physicians and Surgeons, Columbia University.* The resuscitation of hypothermic, supercooled and frozen mammals; follow-up studies of cases from World War II and the Korean War; hypothermia during open heart surgery; cerebral studies during local and general hypothermia; roentgenologic and histopathologic studies of frostbitten rabbits; experimental cold injury and immersion foot in the rabbit are among the topics covered in this well illustrated volume. **$5.95**

GESTATION

Transactions of the Third Conference. *Edited by Claude A. Villee, Assistant Professor of Biological Chemistry, Harvard University.* Much new and pertinent data on maternal endocrine secretions, maternal hormones in pregnancy, ovulation cycles and stress, the activity of the adrenal cortex in pregnancy, steroidogenesis in perfused human placentas, the etiology of gonadal agenesis and sex reversal, the effect of hormones on cellular metabolism, activities of fetal endocrine glands and the influence of hormones on sex differentiation in explanted fetal reproductive tracts will be found in this stimulating book. **$4.75**

PHYSIOLOGY OF PREMATURITY

Transactions of the First Conference. *Edited by Jonathan T. Lanman, Department of Pediatrics, New York University-Bellevue Medical Center.* This volume inaugurates a new series and is the first of five which will appear on the Physiology of Prematurity. The multidiscipline conference group discussed at length the fetal-maternal endocrinology in late pregnancy and the fetal and placental circulation in late pregnancy. **$3.25**

JOSIAH MACY, JR. FOUNDATION PUBLICATIONS
16 WEST 46th STREET, NEW YORK 36, NEW YORK

Please make checks payable to Josiah Macy, Jr. Foundation

Synge (North Holland; Interscience), 27 Apr. 1956, 732

Rheology, Theory and Applications, vol. 1, F. R. Eirich, Ed. (Academic), 22 Mar. 1957, 557

Solid State Physics, F. Seitz and D. Turnbull, Eds. (Academic), vol. 1, 10 Aug. 1956, 279; vol. 2, 25 Jan. 1957, 161

Spectroscopy at Radio and Microwave Frequencies, D. J. E. Ingram (Philosophical Library), 8 Mar. 1957, 449

Statistical Mechanics, Principles and Selected Applications, T. L. Hill (McGraw-Hill), 28 Dec. 1956, 1296

Techniques Générales du Laboratoire de Physique, vol. 1, J. Surugue (Centre National de la Recherche Scientifique), 21 Sept. 1956, 543

Thermal Power from Nuclear Reactors, A. S. Thompson and O. E. Rodgers (Wiley; Chapman & Hall), 29 June 1956, 1182

Physiology, Genetics, Zoology

Advances in Genetics, vol. 7, M. Demerec, Ed. (Academic), 6 July 1956, 35

The American Arbacia and Other Sea Urchins, E. B. Harvey (Princeton Univ. Press), 16 Nov. 1956, 987

Anatomy of the Honey Bee, R. E. Snodgrass (Cornell Univ. Press), 19 Oct. 1956, 730

Annual Review of Entomology, vol. 1, E. A. Steinhaus and R. F. Smith, Eds. (Annual Reviews), 27 Apr. 1956, 742

Biology of the Laboratory Mouse, Staff of Roscoe B. Jackson Memorial Laboratory, G. D. Snell, Ed. (Dover), 5 Oct. 1956, 631

The Biology of Senescence, A. Comfort (Rinehart), 7 Sept. 1956, 446

Biochemical Mechanisms in Inflammation, V. Menkin (Thomas), 10 Aug. 1956, 278

The Blood-Brain Barrier with Special Regard to the Use of Radioactive Isotopes, L. Bakay (Thomas), 27 Apr. 1956, 740

Blood Group Substances, E. A. Kabat (Academic), 8 June 1956, 1041

Body Measurements and Human Nutrition, J. Brožek, Ed. (Wayne Univ. Press), 14 Dec. 1956, 1211

Bone, and Introduction to the Physiology of Skeletal Tissue, F. C. McLean and M. R. Urist (Univ. of Chicago Press), 27 Apr. 1956, 740

Chazyan and Related Brachiopods, G. A. Cooper (Smithsonian Institution), 1 Feb. 1957, 198

Comparative Endocrinology of Vertebrates, I. C. Jones and P. Eckstein, Eds. (Cambridge Univ. Press), pt. 1, 8 June 1956, 1042; pt. 2, 29 June 1956, 1182

Creatures of the Deep Sea, K. Günther and K. Deckert (Scribner), 19 Oct. 1956, 729

The Dynamics of Living Protoplasm, L. V. Heilbrunn (Academic), 31 Aug. 1956, 411

Electro-Sleep, V. A. Giliarovskii, N. M. Liventsev, Yu. E. Segal, Z. A. Kirillova (State Publishing House of Medical Literature, Moscow), 11 May 1956, 851

Embryologie, D. Starck (Thieme), 27 Apr. 1956, 741

Evolution and Classification of the Mountain Caddisflies, H. H. Ross (Univ. of Illinois Press), 15 Mar. 1957, 505

Evolution, Genetics, and Man, T. Dobzhansky (Wiley; Chapman & Hall), 27 Apr. 1956, 743

Faune de France, A. Hoffmann (Lechevalier), 18 May 1956, 898

Fertilization, Lord Rothschild (Methuen; Wiley), 26 Oct. 1956, 827

First Book of Animals, Editors of *Scientific American* (Simon and Schuster), 27 Apr. 1956, 729

Genetics and Metabolism, R. P. Wagner and H. K. Mitchell (Wiley; Chapman & Hall), 31 Aug. 1956, 410

Gestation, C. A. Villee, Ed. (Josiah Macy, Jr., Foundation), 24 Aug. 1956, 369

Histologie und Mikroskopische Anatomie des Menschen, W. Bargmann (Thieme), 14 Sept. 1956, 492

Hormones and the Aging Process, E. T. Engle and G. Pincus, Eds. (Academic), 6 Oct. 1956, 632

An Illustrated Catalogue of the Rothschild Collection of Fleas (Siphonaptera) in the British Museum (Natural History). vol. 2, *Coptopsyllidae, Vermipsyllidae, Stephanocircidae, Macropsyllidae, Ischnopsyllidae, Hypsophthalmidae* and *Xiphiopsyllidae,* G. H. E. Hopkins and M. Rothschild (British Museum), 31 Aug. 1956, 412

International Review of Cytology, G. H. Bourne and J. F. Danielli, Eds. (Academic), vol. 4, 1 June 1956, 995; vol. 5, 8 Mar. 1957, 451

Louisiana Birds, G. H. Lowery, Jr. (Louisiana State Univ. Press), 8 June 1956, 1041

The Marine and Fresh-Water Plankton, C. C. Davis (Michigan State Univ. Press), 11 May 1956, 852

Modern Views on the Secretion of Urine, F. R. Winton, Ed. (Little, Brown), 7 Dec. 1956, 1153

The Myology of the Whooping Crane, Grus americana, vol. 24, H. I. Fisher and D. C. Goodman (Univ. of Illinois Press), 7 Sept. 1956, 446

Parasites and Parasitism, T. W. M. Cameron (Methuen; Wiley), 11 Jan. 1957, 77

The Physics and Chemistry of Life, Editors of *Scientific American* (Simon and Schuster), 27 Apr. 1956, 729

Physiologie der Zelle, J. Haas (Borntraeger), 1 June 1956, 994

Physiology of Digestion, I. P. Pavlov (Academy of Medical Sciences of the U.S.S.R.), 13 July 1956, 84

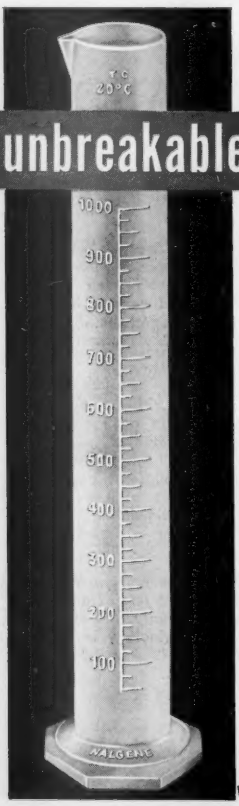
Population Genetics: the Nature and Causes of Genetic Variability in Populations, vol. 20 (Biological Laboratory, Cold Spring Harbor), 29 Mar. 1957, 605

Primates: Comparative Anatomy and Taxonomy, vol. 2, W. C. O. Hill (Interscience; Edinburgh Univ. Press), 25 May 1956, 944

Principles of Embryology, C. H. Waddington (Macmillan), 30 Nov. 1956, 1085

Principles of Renal Physiology, H. W. Smith (Oxford Univ. Press), 13 July 1956, 85

Principles of Zoology, J. A. Moore (Oxford Univ. Press), 5 Apr. 1957, 653



NALGENE HH

unbreakable graduated cylinders

NALGENE HH again proves its superiority in laboratory practice. Because they are light, they are easier to handle. Because they are NALGENE, *they cannot break.* This completely new series of six graduates is manufactured closely to glass graduate specifications and standard dimensions. Octagonal bases prevent rolling. They may be autoclaved under standard conditions.

Ask your dealer for our new catalog E-956.

Cap. ml.	25	50	100	250	500	1000
Subdiv., ml.	1	2	5	10	20	25
Each	3.20	3.40	3.90	4.50	6.50	8.50

Discount: Less 10% in lots of 12 per size

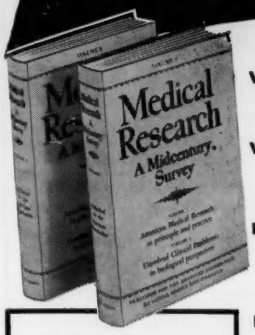
the NALGE CO. Inc.
ROCHESTER 2, N.Y.

WORLD'S LARGEST FABRICATOR OF POLYETHYLENE LABORATORY WARE

Hailed as One of the Great Contributions to Medical Research of Our Time

MEDICAL RESEARCH

A MIDCENTURY SURVEY



Vol. I AMERICAN MEDICAL RESEARCH: in principle and practice

Vol. II UNSOLVED CLINICAL PROBLEMS: in biological perspective

From an Editorial in *Science*:
"An impressive stock-taking and direction-pointing analysis."

From S. G. & O.
"Stands astride the present, born of the past, looking to the future. Read, mark, learn and inwardly digest these books."

From Chester S. Keefer, M.D.:
"The most important and outstanding contribution to the study of medical research of our time."

Published for the American Foundation by Little, Brown & Company. 1956

Price, 2 volumes • 1505 pages • $15.00 at your medical bookstore or from

LITTLE, BROWN & COMPANY
Boston • Toronto

It's

WINTHROP

for AMINO ACIDS

- ARGININE HCl
- ASPARTIC ACID
- CYSTEINE HCl
- CYSTINE
- HISTIDINE
- PHENYLALANINE
- SERINE
- THREONINE
- TRYPTOPHAN
- VALINE

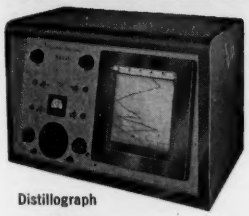
Winthrop LABORATORIES

SPECIAL CHEMICALS DEPARTMENT
1450 Broadway, New York 18, N.Y.

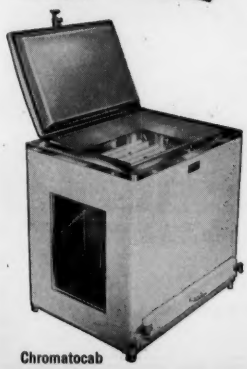
Reco

The COMPLETE LINE of
Specially Designed Equipment for

CHROMATOGRAPHY



Distillograph



Chromatocab

Chromatocabs
Electric Desalter
Drying Oven
Sample Applicator
Solvent Assemblies
Micro Pipets
Stainless Steel Clips
Densitometers
Electrophoresis Apparatus
Distillograph for Vapor Phase Chromatography
Fraction Collector
Drop Counter
Round and Rectangular Jars
Ultra Violet Lamps Long and Short Wave

. . . and other useful accessories

Desalter

CATALOG RE13 describes the Complete Line of RECO Chromatographic Equipment.
Send for your copy today.

RESEARCH EQUIPMENT CORPORATION

1135 Third Street, Oakland, California

AUTHORITATIVE REFERENCE BOOKS

from Van Nostrand

INTERNATIONAL DICTIONARY OF PHYSICS AND ELECTRONICS

Definitions of the principal terms used in classical and modern physics and presented in such a way that they will be useful both to the physicist and to other scientists and engineers whose work is concerned with physical phenomena.
Thumb indexed, Ill., 992 pp. $22.50

DICTIONARY OF MICROBIOLOGY

By MORRIS B. JACOBS, MAURICE J. GERSTEIN and WILLIAM G. WALTER. Clear and explicit definitions of thousands of terms from the entire field of microbiology—from organisms, tests, culture media, chemical compounds and biological processes to applications in industry, medicine, dairy science and agriculture.
Ill., 6 x 9, 299 pp. $6.75

PRINCIPLES OF GUIDED MISSILE DESIGN

A series of six volumes, edited by Grayson Merrill, Captain, U.S.N., setting forth the basic principles of guided missile technology. Written by a team of active specialists and coordinated by a pioneer in the field. GUIDANCE, $12.50; OPERATIONS RESEARCH, ARMAMENT, LAUNCHING, $12.50; AERODYNAMICS, PROPULSION, STRUCTURE AND DESIGN PRACTICE, $12.50; (In preparation) — SYSTEMS ENGINEERING, RANGE TESTING: SPACE FLIGHT; and GUIDED MISSILE DESIGNER'S HANDBOOK.

THE GENEVA SERIES ON THE PEACEFUL USES OF ATOMIC ENERGY

From the many millions of words written for the First International Conference on Peaceful Uses of Atomic Energy, a group of distinguished authors, under the general editorship of Dr. J. G. Beckerley, has prepared six fundamental technical books, each complete in itself. Included are: NUCLEAR FUELS; EXPLORATION FOR NUCLEAR RAW MATERIALS; NUCLEAR REACTORS FOR RESEARCH; (In preparation) — NUCLEAR POWER REACTORS; SAFETY ASPECTS OF NUCLEAR REACTORS; and NUCLEAR RADIATION IN FOOD AND AGRICULTURE. *$42.50 for series, pre-pub. ($8.50 each)*

COMPREHENSIVE INORGANIC CHEMISTRY. *Edited by* M. CANNON SNEED and ROBERT C. BRASTED; VOLUME VI: THE ALKALI METALS, *by* JOHN F. SUTTLE; HYDROGEN AND ITS ISOTOPES, *by* ROBERT C. BRASTED. A review of the literature of chemistry for each of these important elements, providing a comprehensive treatment of the chemistry and technology of each.
250 pages, $5.50

TROPHOBLASTIC GROWTHS — Hydatidiform Mole and Chorionepitheloma. *By* DR. J. SMALBRAAK. A unique picture of current knowledge on both kinds of lesions that is hardly equalled for varying symptomatology, occasional prolonged latency and diverse biological behavior.
360 pages, color illustrations. (An Elsevier book) $12.75

SOLVENTS. *By* THOMAS H. DURRANS. Under one cover the characteristics of all except the rarer industrial solvents and plasticizers. Whether referring to alcohols, glycols, ethers, or lacquer solvents, this unique manual now brought up-to-date in a new seventh edition is more useful than ever.
300 pages, illustrated, $7.50

D. Van Nostrand Co., Inc.

120 Alexander Street, Princeton, N.J.

Procedure in Taxonomy, E. T. Schenk and J. H. McMasters (Stanford Univ. Press), 14 Dec. 1956, 1213

Progress in Biophysics and Biophysical Chemistry, vol. 6, J. A. V. Butler, Ed. (Pergamon), 27 July 1956, 185

Protoplasmatologia Handbuch der Protoplasmaforschung (Springer), vol. 2, J. Small and F. J. Wiercinski, 22 June 1956, 1134; vol. 8, P. G. Lefevre, 29 June 1956, 1181; vol. 10, E. Ponder, 6 July 1956, 37; vol. 11, L. Reuter, 13 July 1956, 84

Physical Techniques in Biological Research, vol. 1, G. Oster and A. W. Pollister, Eds. (Academic), 27 Apr. 1956, 741

Radiation Dosimetry, G. J. Hine and G. L. Brownell, Eds. (Academic), 2 Nov. 1956, 896

Rattlesnakes, L. M. Klauber (Univ. of California Press), 25 Jan. 1957, 161

The Recent Genera of the Caridean and Stenopodidean Shrimps (Class Crustacea, Order Decapoda, Supersection Natantia) with Keys for their Determination, L. B. Holthuis (Brill, Leiden), 27 Apr. 1956, 744

Recent Studies in Avian Biology, A. Wolfson, Ed. (Univ. of Illinois Press), 6 July 1956, 36

Shock and Circulatory Homeostasis, H. D. Green, Ed. (Josiah Macy, Jr., Foundation), 27 Apr. 1956, 745

Some Extinct Elephants, Their Relatives and the Two Living Species, P. E. P. Deraniyagala (Ceylon National Museum), 27 July 1956, 185

The Structure and Function of Skin, W. Montagna (Academic), 24 Aug. 1956, 369

A Symposium on Inorganic Nitrogen Metabolism: Function of Metallo-Flavoproteins, W. D. McElroy and B. Glass, Eds. (Johns Hopkins Univ. Press), 27 Apr. 1956, 740

Temperatur und Leben, H. Precht, J. Christophersen, H. Hensel (Springer), 4 May 1956, 805

Traité de Zoologie, vol. 17 (Masson), 27 Apr. 1956, 743

Travels and Traditions of Waterfowl, H. A. Hochbaum (Univ. of Minnesota Press), 4 Jan. 1957, 28

World Sea Fisheries, R. Morgan (Pitman), 30 Nov. 1956, 1085

Public Affairs

Academic Freedom in Our Time, R. M. *MacIver* (Columbia Univ. Press), 27 Apr. 1956, 726

The American Experiences of Swedish Students, F. D. Scott (Univ. of Minnesota Press), 18 Jan. 1957, 124

American Foundations and Their Fields, W. S. Rich (American Foundations Information Service), 17 Aug. 1956, 326

Atomic Energy for Your Business, A. Kramish and E. M. Zuckert (McKay), 22 Feb. 1957, 355

Atoms and People, R. E. Lapp (Harper), 2 Nov. 1956, 895

Automation, Dept. of Scientific and Industrial Research (H. M. Stationery Office, London), 7 Dec. 1956, 1152

The Development of Academic Freedom in the United States, R. Hofstadter and W. Metzger (Columbia Univ. Press), 27 Apr. 1956, 726

Reports and Publications of the British Government's Department of

SCIENTIFIC AND INDUSTRIAL RESEARCH

- NATIONAL PHYSICAL LABORATORY
- FOOD • ROADS • FUEL
- MECHANICAL ENGINEERING
- HYDRAULICS • RADIO
- GEOLOGICAL SURVEY
- CHEMICALS • BUILDING
- PEST INFESTATION
- FOREST PRODUCTS
- WATER POLLUTION
- FIRE

Write for complete list to

BRITISH INFORMATION SERVICES
45 Rockefeller Plaza, New York 20, New York

Get this FREE Catalog on UNITRON Microscopes!

Here's a typical **UNITRON** *value*

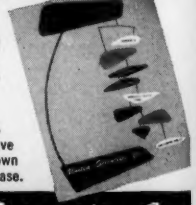
PHASE CONTRAST, MPE

Indispensable for the study of living cells and other highly transparent material without staining. Continuous transition from phase to bright-field microscopy by adjusting condenser height. Choice of 4 contrasts. Mechanical stage. Three phase objectives: P10X, P40X, P100X. Eyepieces: 5X, 10X, P15X.

only $265.

A complete line of Microscopes...
- Metallurgical • Phase
- Laboratory • Polarizing
- Stereoscopic • Student

Used in leading universities, industrial and government laboratories.



FREE 10-DAY TRIAL

Let these instruments prove their value to you, in your own laboratory, before you purchase.

United Scientific Co.
204-6 MILK STREET • BOSTON 9, MASS.

Please rush to me, free of charge, your complete catalog on UNITRON Microscopes.

Name.....
Title.....
Company.....
Address.....
City.....State.....

OXFORD books of exceptional interest

The Physics of Electrical Contacts

By F. L. JONES. A study of the fundamental processes involved in electrical contacts. Describes post-war research on the significant properties of materials used in contacts to give the reader a picture of all of the aspects of contact operation. (*Monographs on the Physics and Chemistry of Materials*) *Illustrated* $5.60

Physical Properties of Crystals, Their Representation by Tensors and Matrices

By J. F. NYE. This systematic treatment of the tensor properties of crystals explains their common mathematical basis and the thermodynamical relations between them. *Text figures.* $8.00

Rectifying Semi-Conductor Contacts

By H. K. HENISCH. A specialized study of rectifying contacts between metals and semi-conductors. Introductory chapters are included for those not familiar with solid state physics. (*International Monographs on Physics*) 120 text figures. $11.20

At all bookstores

OXFORD UNIVERSITY PRESS, Inc.
114 Fifth Avenue, New York 11

Encouraging Scientific Talent, C. C. Cole, Jr. (College Entrance Examination Board), 16 Nov. 1956, 986

Engineering as a Career, R. J. Smith (McGraw-Hill), 18 Jan. 1957, 123

Facing the Atomic Future, E. W. Titterton (Macmillan; St. Martin's), 2 Nov. 1956, 895

Handbook of Scientific and Technical Awards in the United States and Canada, M. A. Firth, Ed. (Special Libraries Association), 26 Oct. 1956, 828

The Mighty Force of Research, Editors of *Fortune* (McGraw-Hill), 27 Apr. 1956, 728

The Negro Potential, E. Ginzberg (Columbia Univ. Press), 28 Sept. 1956, 593

Ninth Annual Report of the Advisory Council on Scientific Policy 1955–1956 (H. M. Stationery Office), 25 Jan. 1957, 162

Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, vol. 8 (United Nations), 30 Nov. 1956, 1085

Report of the Special Committee on the Federal Loyalty-Security Program of the Association of the Bar of the City of New York (Dodd, Mead), 12 Oct. 1956, 688

Research in the Effects and Influences of the Nuclear Bomb Test Explosions, pts. 1 and 2, Committee for Compilation of Reports on Research in the Effects of Radioactivity (Japan Society for Promotion of Science), 5 Apr. 1957, 654

Scientific Books, Libraries and Collectors, J. L. Thornton and R. I. J. Tully (Library Association, London), 27 Apr. 1956, 731

The Soviet Academy of Sciences, No. 3, A. Vucinich (Stanford Univ. Press), 27 Apr. 1956, 728

Soviet Professional Manpower, its Education, Training, and Supply. N. DeWitt (National Science Foundation), 27 Apr. 1956, 727

Technical Education, P. F. R. Venables (Bell; Essential Books), 10 Aug. 1956, 278

The Torment of Secrecy, E. A. Shils (Free Press), 22 June 1956, 1133

Water, U.S. Department of Agriculture (Government Printing Office), 15 June 1956, 1085

The World of Learning, 1956 (Europa Publications), 4 Jan. 1957, 29

Social and Behavioral Sciences

Advances in Food Research, vol. 6, E. M. Mrak and G. F. Stewart, Eds. (Academic), 27 July 1956, 183

Begegnungen mit dem Vormenschen, G. H. R. von Koenigswald (Diederichs), 28 Dec. 1956, 1297

Behavior Theory and Conditioning, K. W. Spence (Yale Univ. Press; Cumberlege, Oxford Univ. Press), 23 Nov. 1956, 1033

Child Development and Personality, P. H. Mussen and J. J. Conger (Harper), 16 Nov. 1956, 987

The Growth and Structure of Motives, J. Olds (Free Press), 1 Mar. 1957, 402

The Image, K. E. Boulding (Univ. of Michigan Press), 21 Dec. 1956, 1255

Information Theory in Psychology, H.

PHILOSOPHICAL LIBRARY BOOKS

☐ **AUTOMATION: ITS PURPOSE AND FUTURE by Magnus Pyke.** A computer can co-ordinate the work of a series of manufacturing operations—it can, in fact, fulfill the function of a human operator. This is "automation." Dr. Pyke reviews what is already being done automatically and discusses the speed with which "automation" is likely to spread here and abroad. $10.00

☐ **CREEP AND FRACTURE OF METALS AT HIGH TEMPERATURES.** An exhaustive review of the progress made in the study of plastic deformation and fracture by 26 eminent specialists. $12.00

☐ **CAVITATION IN HYDRODYNAMICS.** A critique of the progress being made in the field and detailed discussion of the physical aspects of cavitation phenomena. A symposium by 22 eminent scholars. $15.00

☐ **A HANDBOOK OF METALS by W. A. Dawihl.** An abridged translation of "Handbuch Der Hartmetalle" dealing with scientific principles of sintering and the technique of production of hard metals. **Illus.** $10.00

☐ **HIGH-SPEED FLIGHT by E. Ower and J. L. Nayler.** This book explains the human and mechanical problems of very high-speed and supersonic flight, and contains information not hitherto released to the general public. **Illustrated.** $10.00

☐ **BOUNDARY LAYER EFFECTS IN AERODYNAMICS.** A comprehensive survey of this outstanding development in fluid mechanics. A symposium by 16 American and foreign experts. $12.00

☐ **ELECTRONIC COMPUTERS by T. E. Ivall.** A non-mathematical introduction to the mechanism and application of computers employing valves and transistors. Both digital and analogue computers are covered, the bulk of the book being devoted to describing their circuitry, while their rapidly developing applications in industry, commerce and science are also outlined. In the final chapter, the future evolution of computers is discussed. **40 drawings and 25 photos.** $10.00

☐ **ENCYCLOPEDIA OF ATOMIC ENERGY by Frank Gaynor.** More than 2000 entries defining and explaining concepts and terms in nuclear physics and atomic energy makes this volume a vital handbook for all those concerned with atomic science. **Illus., charts, tables.** $7.50

☐ **THE GYROSCOPE by K. I. T. Richardson.** A book, The Gyroscope and Its Applications, was published in 1946 when secrecy restrictions prevented reference to many interesting achievements and possibilities. Since then considerable technical advances have been made and the secrecy restrictions have been relaxed to some extent, although they still apply in many instances. The present book therefore, based on that published in 1946, has been almost entirely rewritten describing much that is new but at the same time incorporating most of the information given in the first version, although this is presented in a different manner and in some cases from a different viewpoint. $15.00

☐ **CONSTRUCTING AN ASTRONOMICAL TELESCOPE by G. Matthewson.** A detailed guide book for the expert as well as the beginner. Second revised edition. **Fully illustrated.** $4.75

☐ **FOUNDATIONS OF RADIO by M. G. Scroggie.** The purpose of this book is to start at the beginning of radio and lay the foundations. All technical terms, symbols, graphs, etc. are explained. Chapters are devoted to The Single-Valve Receiver, Radio-Frequency Amplification, Selectivity, Superheterodyne receiver, Audio Frequency circuits, etc. **Over 235 illustrations.** $10.00

☐ **HISTORY OF MATHEMATICS by Joseph E. Hofmann.** In a wealth of detail Professor Hofmann explores the number systems and methods of ancient peoples, the rule of the great translators of the Middle Ages, the problems and tensions of the Scholastic period. Numerous works of Renaissance and Early Baroque mathematicians are discussed, emphasizing developments which helped to pave the way for modern concepts. $4.75

☐ **DICTIONARY OF MATHEMATICS by C. H. McDowell.** A concise definitive dictionary for students and the general reader. **Many illustrated examples.** $2.75

☐ **PERSONNEL MANAGEMENT: PRINCIPLES AND PRACTICE by C. H. Northcott.** This is the third edition of one of the text-books on the subject, but at least two-fifths of this edition is new material. Developments in the world of personnel management are reflected in the altered emphasis, the book now having been divided into two parts, one dealing with Principles and the other with Practice. In addition, six new chapters have been included and the single chapter on wages has been expanded into three. Up-to-date material has been incorporated into other chapters and the general argument reviewed and recast. $10.00

☐ **OUT OF MY LATER YEARS by Albert Einstein.** The distinguished physicist, always an independent and uncompromising thinker, deals with the most urgent questions of modern society: Social, religious, educational, and racial relationships. $4.75

☐ **A TREASURY OF PHILOSOPHY edited by Dagobert D. Runes.** Here is one of the most comprehensive collections of philosophical writings ever to be gathered between the two covers of one book. In a text of over 1,200 pages, under the more than 375 separate entries, are found, not only the great philosophers of the West, but the important, less familiar, thinkers of the Orient. $10.00

MAIL THIS COUPON TODAY

Mail to your favorite bookseller or directly to
PHILOSOPHICAL LIBRARY, *Publishers*
15 East 40th Street, Desk 2, New York 16, N. Y.
Send books checked. To expedite shipment I enclose remittance $.....

NAME .....

ADDRESS

Quastler, Ed. (Free Press), 27 Apr. 1956, 747

In Search of Adam, H. Wendt (Houghton Mifflin), 23 Nov. 1956, 1031

Learning across Cultures, J. Watson and R. Lippitt (Institute for Social Research, Univ. of Michigan), 3 Aug. 1956, 230

Man in Search of His Ancestors, A. Senet (McGraw-Hill), 23 Nov. 1956, 1031

New Lives for Old, M. Mead (Morrow), 21 Sept. 1956, 541

Psychoanalysis and Psychotherapy. F. Alexander (Norton), 7 Sept. 1956, 444

The Psychology of Human Differences, L. E. Tyler (Appleton-Century-Crofts, ed. 2), 15 June 1956, 1087

Psychology of Industrial Conflict, R. Stagner (Wiley; Chapman & Hall), 23 Nov. 1956, 1032

Research Frontiers in Politics and Government, S. K. Bailey, H. A. Simon, R. A. Dahl, R. C. Snyder, A. de Grazia, M. Moos, P. T. David, D. B. Truman (Brookings Institution), 27 Apr. 1956, 745

A Solomon Island Society, D. L. Oliver (Harvard Univ. Press), 27 Apr. 1956, 746

Studies of the Psychology and Behavior of Captive Animals in Zoos and Circuses, H. Hediger (Butterworths), 28 Sept. 1956, 592

A Study of Thinking, J. S. Bruner, J. J. Goodnow, G. A. Austin (Wiley; Chapman & Hall), 11 Jan. 1957, 75

Suggestion and Hypnosis in the Light of the Concepts of I. P. Pavlov, K. I. Platonov (State Publishing House of Medical Literature, Moscow), 27 July 1956, 184

Theories of Learning, E. R. Hilgard (Appleton-Century-Crofts, ed. 2), 13 July 1956, 83

They've Got Your Number, R. Wernick (Norton), 12 Apr. 1957, 702

Yearbook of Anthropology, 1955, vol. 1, W. L. Thomas, Jr., Ed. (Wenner-Gren Foundation for Anthropological Research), 1 June 1956, 995

Youth in a Soundless World, E. S. Levine (New York Univ. Press), 12 Apr. 1957, 701

Technology

Air Pollution Handbook, P. L. Magill, F. R. Holden, C. Ackley, Eds. (McGraw-Hill), 21 Dec. 1956, 1255

Automatic Control, Editors of *Scientific American* (Simon and Schuster), 27 Apr. 1956, 729

Chemical Engineering, vol. 2, J. M. Coulson and J. F. Richardson (McGraw-Hill; Pergamon), 27 Apr. 1956, 737

Chemical Engineering Practice, vol. 1, H. W. Cremer, Ed. (Academic; Butterworths), 29 Mar. 1957, 605

The Chemistry of Tanning Processes, K. H. Gustavson (Academic), 6 July 1956, 36

Chemistry and Uses of Pesticides, E. R. de Ong (Reinhold; Chapman & Hall), 25 Jan. 1957, 162

Combustion Processes, vol. 2, *High Speed Aerodynamics and Jet Propulsion,* B. Lewis, R. N. Pease, H. S. Taylor, Eds. (Princeton Univ. Press), 17 Aug. 1956, 324

Computers, E. C. Berkeley and L. Wainwright (Reinhold; Chapman & Hall), 21 Dec. 1956, 1255

Documentation in Action, J. H. Shera, A. Kent, J. W. Perry (Reinhold; Chapman & Hall), 22 Mar. 1957, 556

Experimental Stress Analysis in the U.S.A. and Canada, Dept. of Scientific and Industrial Research (H. M. Stationery Office, London), 28 Dec. 1956, 1298

Fire Research, 1955 (H. M. Stationery Office, London), 23 Nov. 1956, 1033

Let ERMA Do It, D. O. Woodbury (Harcourt, Brace), 22 Mar. 1957, 556

Molybdenum, L. Northcott (Academic; Butterworths), 1 Mar. 1957, 401

Physics of Fibres, H. J. Woods (Institute of Physics, London), 11 May 1956, 853

Principles of Color Television, Hazeltine Laboratories Staff, K. McIlwain and C. E. Dean, Eds. (Wiley; Chapman & Hall), 22 Feb. 1957, 357

Principles of Guided Missile Design, Guidance, A. S. Locke, C. H. Dodge, S. F. George. L. F. Gilchrist, W. C. Hodgson, J. E. Meade, J. A. Sanderson, C. F. White (Van Nostrand), 27 Apr. 1956, 734

Principles of Physical Metallurgy, M. C. Smith (Harper), 27 Apr. 1956, 735

Rockets and Guided Missiles, J. Humphries (Macmillan), 10 Aug. 1956, 279

Titanium, A. D. McQuillan and M. K. McQuillan (Academic), 15 June 1956, 1085

Ultrasonic Engineering with Particular Reference to High Power Applications, A. E. Crawford (Academic; Butterworths), 7 Sept. 1956, 445

LARGEST MANUFACTURER OF SUPER-SPEED CENTRIFUGES!

Super-Speed... Large Volume!...

The Model LR features a new design refrigeration system which employs forced air circulation through side and bottom cooling areas to provide a continuous laminar flow of cool air streams onto all portions of the rotor. Chamber temperatures may be set as low as −15°C and automatically maintained within ±1°C. Rotor compartment temperatures are easily maintained at 0°C and lower, even during runs at maximum speed for extended periods.

Instrumentation includes a continuous reading electric tachometer, two hour timer, automatic temperature controller, variable speed controller, ammeter for rotor acceleration control and various operating safety controls.

A full 1 Hp. Universal motor provides direct power to any rotor employed, without the use of cumbersome high speed attachments, pulleys or gears. All rotors are interchangeably used in both refrigerated and non-refrigerated Lourdes' centrifuges without the use of special adapters.

More compact and less expensive than any other superspeed refrigerated centrifuge, the Model LR offers highest quality construction, maximum operating efficiency and unsurpassed performance.

LOURDES

refrigerated centrifuge

Write For New LOURDES' Centrifuge CATALOG S47b

Model LR

FOUR INTERCHANGEABLE ROTORS

ROTOR	CAPACITY (Max.)	RPM (Max.)	RCF x G (Max.)
11° Angle	1,500cc (6x250cc)	11,000	20,000
9° Angle	400cc (8x50cc)	15,300	30,000
9° Angle	360cc (24x15cc)	15,300	30,000
Swinging Cup	96cc (8x12cc)	12,000	21,500

NOTE: Adapters available for smaller tubes.

Backed by over a decade of laboratory centrifuge manufacturing experience, each LOURDES' unit is guaranteed for a period of one year.

LOURDES INSTRUMENT CORPORATION

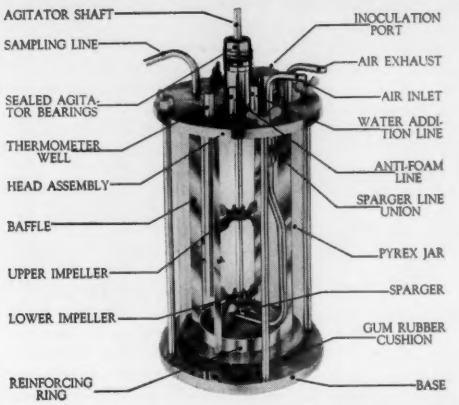
53rd STREET and 1st AVENUE • BROOKLYN 32, N. Y.

LOURDES' CENTRIFUGES AVAILABLE AT THESE DEALERS

Ace Scientific Supply Co., Inc.
Aloe Scientific Div. of A. S. Aloe Co.
A. Daigger & Co.
Erb & Gray Scientific
Federal Scientific
Adolf Frese Corp.
Arthur S. Lapine & Co.
Macalaster Bicknell Co.
New Brunswick Scientific Supply Co., Inc.
Standard Scientific Supply Corp.
Technical Products Co.
U. S. Industrial Scientific Co., Inc.
Wilkens-Anderson Co.
Canadian Laboratory Supplies Ltd.

5-7.5-14 Liter Capacity Fermentors

for the study of metabolic processes in submerged culture



All stainless steel with Pyrex jar for full visibility. Entire assembly fits in autoclave for thorough sterilization. Non-freezing, non-bleeding agitator housing and seals.

UNCONDITIONAL ONE YEAR GUARANTEE

Write for Bulletin F

NEW BRUNSWICK SCIENTIFIC CO.

PRECISION LABORATORY APPARATUS

P. O. BOX 606 • NEW BRUNSWICK, N. J.

NOW READY

The Chemical Basis of Heredity

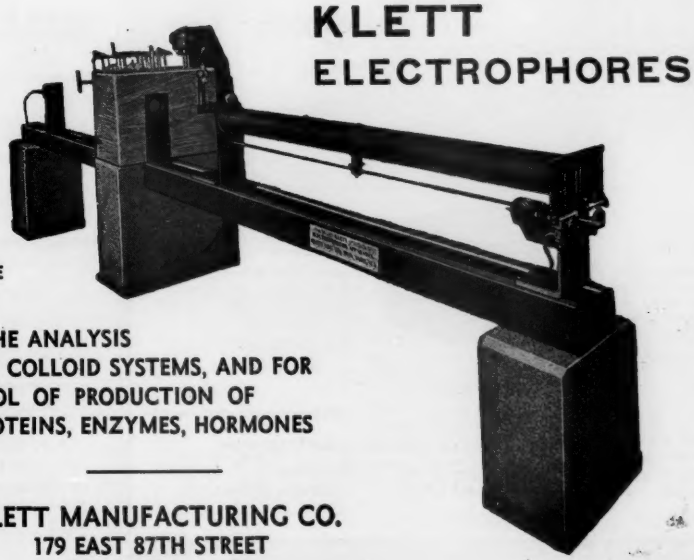
Edited by William D. McElroy and Bentley Glass

In June, 1956, the McCollum-Pratt Institute brought together scientists from all over the world who are actively engaged in investigating the chemistry of heredity. The fruits of their research—chemical, biochemical, organismal, genetical—are presented in this book, giving the most up-to-date answers available to the basic problems of the nature of the gene and the mechanism of gene action.

864 pages Author and subject index $12.50

THE JOHNS HOPKINS PRESS, Baltimore 18, Md.

KLETT ELECTROPHORESIS



CUSTOM MADE

TOOL FOR THE ANALYSIS OF COMPLEX COLLOID SYSTEMS, AND FOR THE CONTROL OF PRODUCTION OF PURIFIED PROTEINS, ENZYMES, HORMONES

KLETT MANUFACTURING CO.
179 EAST 87TH STREET
NEW YORK, N. Y.

Forthcoming Events

May

21–25. American Assoc. on Mental Deficiency, Hartford, Conn. (T. L. McCulloch. Letchworth Village, Thiells, N.Y.)

22–24. American Inst. of Chemists, annual, Akron, Ohio. (L. Van Doren, AIC, 60 E. 42 St., New York 17.)

22–24. American Soc. for Quality Control, annual, Detroit, Mich. (L. S. Eichelberger, A. O. Smith Corp., Milwaukee 1, Wisc.)

22–25. International Scientific Radio Union, national spring mtg., Washington, D.C. (J. Hagen, U.S.A. National Committee URSI, National Acad. of Sciences, 2101 Constitution Ave., NW, Washington 25.)

23–25. Acoustical Soc. of America, New York, N.Y. (W. Waterfall, ASA, 57 E. 55 St., New York 22.)

25–26. International Cong. for the Study of the Bronchi, Lisbon, Portugal. (F. Lopo de Carvalho, 138 rua de Junqueira, Lisbon.)

25–28. International Cong. of Acupuncture, 9th, Vienna, Austria. (Austrian Assoc. for Acupuncture, 57 Schwenderstrasse, Vienna.)

26–30. Special Libraries Assoc., annual, Boston, Mass. (Miss M. E. Lucius, SLA, 31 E. 10 St., New York 3.)

27–29. American Gynecological Soc., Hot Springs, Va. (A. A. Marchetti, 3800 Reservoir Rd., NW, Washington 7.)

27–29. Cerebrospinal Fluid, Production, Circulation and Absorption, CIBA symp. (by invitation), London, England. (G. E. W. Wolstenholme, 41 Portland Pl., London, W.1.)

29–2. American College of Chest Physicians, annual, New York, N.Y. (M. Kornfeld, ACCP, 112 E. Chestnut St., Chicago 11, Ill.)

30–31. American Geriatrics Soc., New York, N.Y. (R. J. Kraemer, Greenwood, R.I.)

30–31. Rheology of Elastomers, conf., Welwyn Garden City, Herts., England. (N. Wookey, British Soc. of Rheology, 52, Tavistock Rd., Edgware, Middlesex, England.)

30–1. American Acad. of Dental Medicine, 11th annual, Boston, Mass. (R. Diamond, 100 Boylston St., Boston.)

30–1. American Malacological Union, Pacific meetings, Santa Barbara, Calif. (Miss M. C. Teskey, P.O. Box 238, Marinette, Wis.)

30–1. American Ophthalmological Soc., Hot Springs, Va. (M. C. Wheelen, 30 W. 59 St., New York 19.)

30–1. Endocrine Soc., 39th annual, New York, N.Y. (H. H. Turner, 1200 N. Walker St., Oklahoma City 3, Okla.)

31–2. American Soc. for the Study of Sterility, New York, N.Y. (H. Thomas, 920 S. 19 St., Birmingham 5, Ala.)

31–2. Social Medicine, internatl. cong., Vienna, Austria. (T. Antome, Spitalgasse 23, Vienna 9.)

31–2. Society for Applied Anthropology, annual, East Lansing, Mich. (W. F. Whyte, New York State School of Industrial and Labor Relations, Cornell Univ., Ithaca, N.Y.)

June

1–2. American Diabetes Assoc., 17th annual, New York, N.Y. (ADA, 1 E. 45 St., New York 17.)

1–2. Soc. for Investigative Dermatology, annual, New York, N.Y. (H. Beerman, 255 S. 17 St., Philadelphia 3, Pa.)

1–9. International Cong. on Medicine and Surgery, Turin, Italy. (Secretariat, Minerva Medica, Corso Bramante 83–85, Turin.)

2–6. Air Pollution Control Assoc., golden anniversary, St. Louis, Mo. Jointly with American Meteorological Soc., American Soc. of Heating and Air Conditioning Engineers, American Inst. of Chemical Engineers, and American Soc. of Mechanical Engineers. (H. C. Ballman, APCA, 4440 Fifth Ave., Pittsburgh 13.)

2–7. Society of Automotive Engineers, summer, Atlantic City, N.J. (Meetings Division, SAE, 29 West 39 St., New York 18.)

2–8. International Cong. of Photobiology, 2nd Turin, Italy. (G. Matli, Istituto di Fisica dell'Universita di Torino, Via Pietro Giuria 1, Corso Massimo d'Azeglio 46, Turin.)

3–5. American Soc. of Refrigerating Engineers, Miami Beach, Fla. (R. C. Cross, ASRE, 234 Fifth Ave., New York 1.)

3–5. Chemical Inst. of Canada, 40th annual, Vancouver, B.C. (CIC, 18 Rideau St., Ottawa 2, Ont.)

(See issue of 19 April for comprehensive list)

NOW!
DISPOSABLE PETRI DISHES
in new, convenient
DISPENSER!

These disposable, plastic Petri Dishes are made of clear, pyrogen-free plastic containing no inhibiting agents and are inert to most biological reagents. Twenty 100-mm dishes are packed in a handy cardboard dispenser.

STERILE
Dishes are sterilized after packaging and meet the requirements for sterility established by the U.S. Pharmacopeia.

ECONOMICAL
No time-consuming washing and autoclaving is necessary before use—Dishes are ready for use when taken from dispenser.

DISPOSABLE
Dishes are designed as SINGLE-USE sterile Petri Dishes and can be disposed of by incineration after growth has been destroyed in the usual manner.

UNBREAKABLE
These plastic dishes eliminate the dangers of breaking and the ensuing danger of infections from cuts.

UNIFORM
Dishes are clear and scratch-free. Each dish is the same size, making it easy to control the nutrient depth.

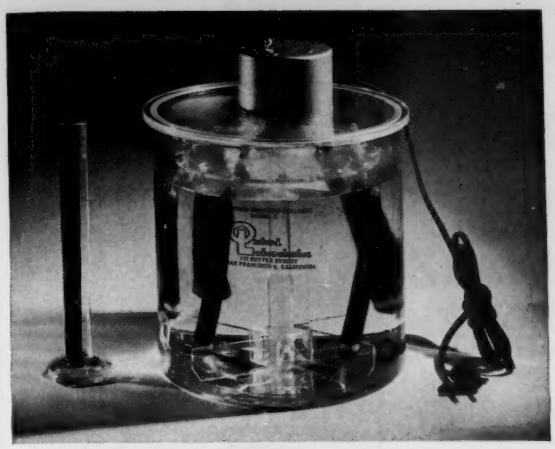
ORDER TODAY!

Cat. No. 52485 PLASTIC PETRI DISHES, with cover, 100-mm diameter (case of 100 dishes) ..... per case $9.95

Cat. No. 52485A Same as above but in cases of 500 dishes ..... per case $44.00

6–14 cases per case $39.60 | 30–249 cases per case $35.75
15–29 cases per case $37.60 | 250 cases per case $34.95

STANDARD SCIENTIFIC Supply Corp. 808 BROADWAY NEW YORK 3, N.Y.
LABORATORY APPARATUS REAGENTS AND CHEMICALS



simple • flexible • inexpensive

MULTI-PURPOSE DIALYZER

Providing for 16 separate samples, each up to 20 ml, the Oxford Model B Dialyzer has a buffer capacity up to 5 liters. The unit is particularly useful for concentrating dilute protein samples for paper electrophoresis and for treating protein fractions prepared by the continuous-flow curtain method.

Arranged for utmost convenience, the Model B revolves samples in a circular path as shown in the illustration. Samples are separately contained in lengths of cellophane tubing. Baffles at the bottom of the Pyrex brand glass tank contribute a maximum dialyzing efficiency by giving both internal agitation to the sample and external agitation to the buffer.

Send for further details. Write:

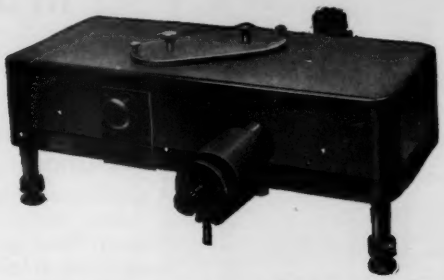
Oxford Laboratories

111 SUTTER STREET • SAN FRANCISCO 4 • CALIFORNIA

LEISS

Single and Double

MIRROR-MONOCHROMATORS



with exchangeable prisms for the visible, ultraviolet, infrared from 200 millimicrons to 20 microns

Write for Bulletin #980 to

PHOTOVOLT CORP.

95 Madison Ave. New York 16, N. Y.

BIRD

Kymograph Recording Camera

This instrument makes possible the recording of many physiological reactions by the photographic process. It is modestly priced and is suitable for student demonstration purposes and student use. The kymograph movement is from our standard 70–140 continuous feed kymograph.

The speeds in cms per minute are approximately:

Used in conjunction with a light source (including focusing lens and vertical exit slit) and a mirror galvanometer, or other type of optical lever, the physiological action under observation is recorded on the paper as the vertical line of light travels back and forth along the adjustable horizontal slit in the front panel of the camera.

	With change gears in normal position	In reverse
1st	2.2	4.3
2nd	11.0	21.5
3rd	55.0	107.5
4th	275.	537.5

The supply roll quill accommodates a roll of Linagraph No. 483 paper 100 feet long by 6 inches wide.

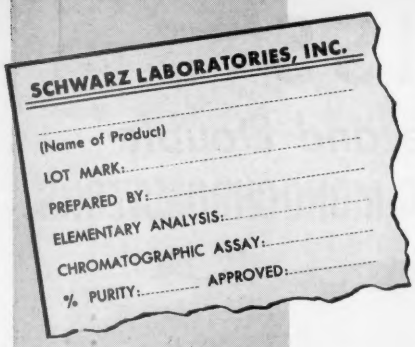
The camera may be detached from the driving unit, by turning a single knurled screw, and removed to a dark room for loading or unloading. The driving unit and base need not be disturbed during this procedure.

Kymograph Recording Camera with one roll of Linagraph No. 483 paper	**$425.00**
Linagraph Paper No. 483 in rolls 6 inches wide, 100 feet long	**per roll $12.00**

PHIPPS & BIRD, INC.

Manufacturers & Distributors of Scientific Equipment

6th & Byrd Streets - Richmond, Va.



How High Quality is Assured in SCHWARZ Biochemicals

Some **SCHWARZ** Fine Chemicals for Industry and Research

- Purines and Pyrimidines
- Phosphorylated Adenosine Compounds
- Cozymase
- Nucleosides and Nucleotides
- Nucleic Acids and Metallic Nucleates
- Sugar Phosphates
- Glutathione
- Sulfhydryl Reagents
- Sugars
- Triphenyl Tetrazolium Chloride
- Deoxynucleosides
- Optically Standardized Amino Acids
- Radioactive Chemicals

High Specifications Are Established

A specification sheet delineates the quality of every chemical manufactured by Schwarz. These specifications are prepared in our Research Laboratories and are based on careful literature searches for the correct values.

Each Lot Must Meet These Specifications

Every lot of Schwarz compound is analyzed in our Control Laboratories before it leaves the production laboratory. Each assay must meet the specifications set forth. The assay slip must be approved by the head of our research group.

Complete Records Are Kept For Each Lot

A lot number appears on *every* shipment of fine chemicals made by Schwarz. A copy of the analysis of each lot is filed in our *Order* Department—so every purchaser instantly may be given data he may need.

Extensive Research Is Maintained

Schwarz research is intensively directed to the commercial production of cell substances. Schwarz Laboratories was the first and in many cases is the only manufacturer of a number of important biochemicals.

All Operations Are Guided By Long Experience

Schwarz Laboratories has a long record of accomplishment and leadership in manufacturing biochemical intermediates. It is the oldest and largest manufacturer in the world of nucleic acid and its related derivatives. You can rely on Schwarz.

SCHWARZ LABORATORIES, INC.

230 Washington Avenue **Mount Vernon, New York**

SL 351

LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see Science **124**, *249 (1956) and* **125**, *16 (4 Jan. 1957).*

Reference Citations

The citation of references in scientific papers should enable the reader to locate the specific point in the referent article quickly and efficiently. The usual method of citing a reference does not accomplish this purpose, for, ordinarily, only the first page of the article or the inclusive pages are given in the reference. Only in the case of books is the page number given. When a highly specific point is made, which may be buried in a table, footnote, or paragraph, it frequently becomes a very difficult task to locate and verify the information, especially when the paper is long or involved. We have run into this difficulty, especially in citations for enzymatic inhibitors, activators, melting points and other physical constants, and data and procedures which may be incidental to the main subject of the paper.

It is, therefore, suggested that when a highly specific point is referred to in a paper, the usual reference be given in whatever style the journal requires, followed by a more specific citation in parentheses. The following hypothetical example will illustrate this point. A. N. Jones and J. A. Smith, *J. Biol Chem.* **89**, 54 (1984) (p. 56), (56), or (56, Table III), or (56, paragraph 2), and so forth.

The attention of editors of scientific journals to this matter is recommended.

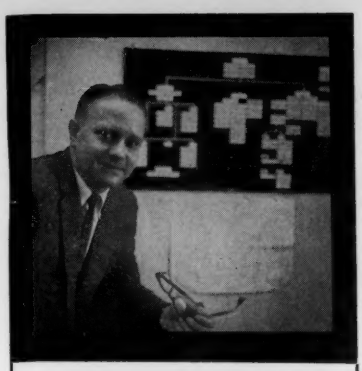
MORRIS N. GREEN
Newton Centre, Massachusetts
HERBERT N. SCHLEIN
West Roxbury, Massachusetts

When authors of papers supply the information, Science *does just what Green and Schlein ask for, although not exactly in the form that they suggest.*

Tools for Communication

Language is our box of tools for thinking and for communication. The tools (words) ought to be kept sharp (precisely defined). The invention of new tools (words and symbols) for new uses (concepts), and for the old ones too, is to be encouraged. The sooner an inconvenient tool is replaced by a more effective one, the better.

I have a pet aversion, namely, the term *milligrams percent,* meaning milligrams of solute in 100 milliliters of solu-



qualifications?

"With the *right* qualifications," says Dr. Frank C. Brooks, Director of the Combat Operations Research Group of Technical Operations, Incorporated, "a scientist who wants to *grow* fits in here. We're a growing research organization with freedom to think, in an atmosphere of creative opportunity. Right now, at Fort Monroe, Va. and Monterey, Calif., we're looking for an

Applied Mathematician or Logician

who combines strong backgrounds in logic and mathematics, with a knowledge of computer logic and experience in computer applications. We also need an

Experimental or Theoretical Physicist

preferably on the Ph.D. level with two years of experience beyond the degree.

The positions at Fort Monroe are on research and analysis teams tackling theoretical problems in military organization and tactics, using combat models and war games. At Monterey, the emphasis is on the experimental study of combat, using the techniques of design and analysis of experiments and high speed computing."

Address:
ROBERT L. KOLLER
Operations Research Group

tech/ops

TECHNICAL OPERATIONS, INCORPORATED

South Avenue
Burlington, Massachusetts

tion. *Percent* and *per mille* and *parts per million* are easy and have convenient symbols: %, ‰, and ppm. It is true that it is inconvenient to write 0.015%, or 0.15‰, or concentration of 1.5×10^{-4}, or 150 ppm. To write *15 mg percent*, which is present custom in our clinical laboratories, seems to me not much of an improvement. *Fifteen milligrams percent* does run off the tongue quite smoothly. *One hundred fifty parts per million*, however, runs just as smoothly and is only 12 percent longer.

Now I have an invention. It is to use, instead, the East Indian word for 100,000, namely, *lac. Fifteen milligrams percent* then becomes *15 per lac.*

R. R. NEWELL
Stanford University School of Medicine, San Francisco, California

Insect Control by Radiation

In the article "Current status of insect control by radiation" [*Science* **124**, 1011 (1956)], Charles C. Hassett gives a table of costs per ton for a 50,000-roentgen dose from various sources in which some of the data appear to be misleading. In particular, I think that the figures given for electron accelerators are a little unrepresentative and, in this connection, I would like to call attention to data given by Wolfgang Huber [*Western Canner and Packer* (Aug. 1956)]. Huber shows that, for a dose of 50,000 roentgens (approximately 0.05 Megarep) at 50-percent utilization, machines are available that can treat more than 100 tons per hour at a cost of 40¢ per ton or less.

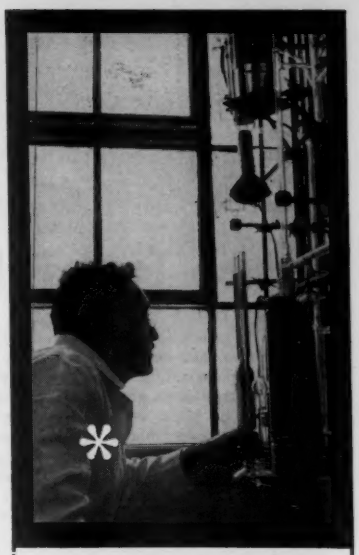
I should also like to point out that there appears to be a discrepancy in Hassett's stated cost of the cobalt-60 irradiation unit: "$10 per ton (5¢ per pound)."

M. C. CROWLEY-MILLING
Accelerator Laboratory, Metropolitan-Vickers Electrical Company, Manchester, England

The article by Huber, referred to by M. C. Crowley-Milling, appeared after my article had been written and submitted for clearance; hence, it could not be included in my discussion. The data cited actually reinforced my conclusions: that these machines will soon make large-scale radiation economically feasible.

With reference to Crowley-Milling's second point, the manuscript submitted to *Science* shows the correct values: "$10 per ton (0.5¢ per pound)." This typographic error unfortunately passed both *Science's* proof reading and mine.

CHARLES C. HASSETT
Entomology Branch, Chemical Warfare Laboratories, Army Chemical Center, Maryland



Amplification

The billion-fold amplification of the image left by light in silver halides, a problem which has interested many scientists, is only one of current problems being attacked by Technical Operations, Incorporated. Your association with Technical Operations' scientific staff can mean comparable amplification.

for your career as a

Chemist

It can also mean:

- simple, sensible salary policies
- management by scientists
- long-range security
- unusual joint company-employee savings plan

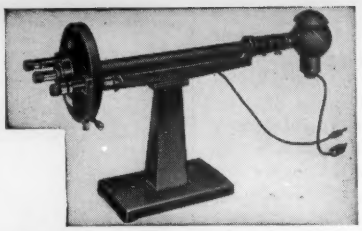
Senior scientists will find limitless opportunity in experimental research and development—in chemistry, physics, nucleonics and electronics. Challenging positions are available in theoretical work in physics, operations research, and other fields.

*Dr. Bernard Manning, of Technical Operations' Chemistry Group.

address: Robert L. Koller

TECHNICAL OPERATIONS
INCORPORATED
Research and Development
for business, industry and government

6 Schouler Court
Arlington 74, Massachusetts



NEW

Lippich Type Polarimeter

(Schmidt & Haensch)

A precision instrument for measuring the rotation of the plane of polarization of all optically active substances. Big advantage is its glass circle instead of a metal circle. The scale on glass, instead of on metal, in conjunction with a micrometer plate, permits direct reading without vernier, resulting in greater speed and precision of reading. Glass circle is rigidly connected with the analyzer and carries two scales, an angular scale in degrees arc and a scale in international sugar degrees. Sodium vapor lamp is an integral part of the instrument and is always in alignment and ready for use.

Model A with receiving trough for tubes up to a length of 220 mm.
Model B with receiving trough for tubes up to a length of 400 mm.

Bulletin SH-344 on request

FISH-SCHURMAN CORPORATION
74 Portman Road New Rochelle, N. Y.

Fish-Schurman

CLAY ADAMS

Depend on Clay-Adams . . .

The *preferred* source of supply for leading hospitals, laboratories and teaching institutions. Quality products through leading scientific dealers everywhere. Our 216-page catalog describes 1161 products.

Clay-Adams

141 East 25th Street • New York 10

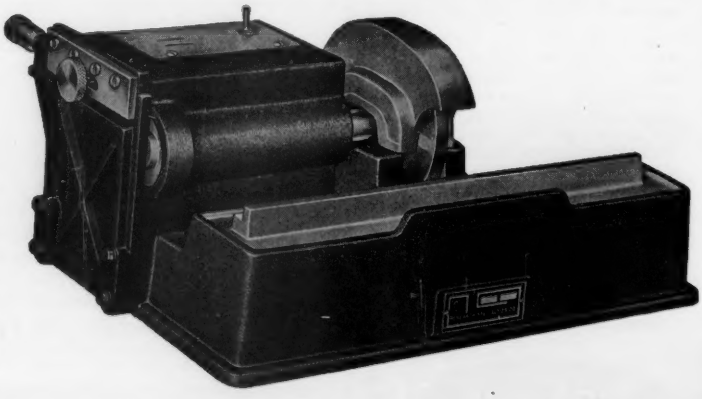
Look for these familiar trade names—your assurance of quality! Adams Centrifuges • Yankee Rotators • Gold Seal Slides and Cover Glasses • Adams Laboratory Counters • Counting Chambers Yankee Shakers • Medichromes

MICROTOME KNIFE SHARPENER

RSCo Model 2200

IMPROVED DESIGN
LONGER LIFE
LESS COMPLEX OPERATION
SIMPLIFIED MAINTENANCE

The RSCO Model 2200 MICROTOME KNIFE SHARPENER, an improved design based on the well-known glass wheel and liquid abrasive suspension principle, keeps microtome knives in excellent condition for the most exacting of sectioning requirements, and it produces a sharpened and polished edge far superior to that obtainable by other methods.



WRITE FOR BULLETIN 2200

RSCo RESEARCH SPECIALTIES COMPANY

2005 Hopkins Street, Berkeley 7, California

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ CENTRIFUGE is provided with a sealed rotor cover that prevents escape of contents. The seal is made by an O ring. The new cover may be used with existing centrifuges made by the same manufacturer. (Ivan Sorvall, Inc., Dept. S289)

■ VACUUM GAGE of Pirani type covers a range of pressures from 1 to 2000 μHg. Up to four gage stations are accommodated by a single instrument. The Pirani tube operates at a maximum temperature of 250°C, and deposits on the filament do not change its emissivity. Operating voltage is automatically regulated. A special circuit permits operation as a leak detector at pressures from 1 μ to 10 mm-Hg. (Consolidated Electrodynamics Corp., Dept. S284)

■ ION-EXCHANGE RESINS of analytic grade are described in a folder that contains, in addition to prices, data which must be considered in selecting specific ion-exchange resins. The effects of functional groups, cross linkage, and particle size are discussed. (Bio-Rad Laboratories, Dept. S269)

■ PULSE GENERATOR output is variable from 1 to 10 v by a ten-turn potentiometer and a step-type attenuator. Drift rate is less than 0.005 per cent/hr or 0.02 percent/day. Repetition rate is fixed at 60 pulses/sec. Rise time is 7 msec. (Franklin Electronics, Inc., Dept. S286)

■ ANTENNA HORNS for frequencies ranging from 1000 to 40,000 Mcy/sec are offered in standard or special designs. Beam width and antenna gain can be provided to individual specifications. Silver and rhodium are used for all internal electric working surfaces. (J. V. M. Engineering Co., Dept. S271)

■ SPRING-LOADED THERMOCOUPLE is designed for applications where pressure contact is required for efficient temperature measurement. The tip of the thermocouple is held against the work surface by an Inconel-X spring that can stand temperatures up to 900°F. The spring accommodates motion caused by expansion and contraction. (Minneapolis-Honeywell Regulator Co., Dept. S292)

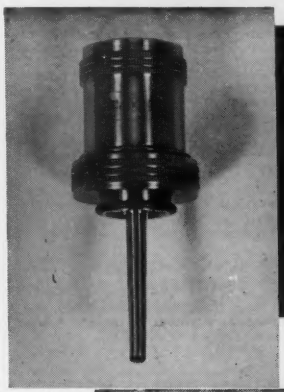
■ DIGITAL INDICATOR provides digital indication of analog quantities by means of an electronic null-balance servo system that drives a set of geared number wheels. Numbers are 7/16 in. high. Nonlinear inputs are linearized by a tapped slidewire. (Performance Measurements Co., Dept. S287)

■ DELAY CABLE has a flexible, low-loss, magnetic core. Delay is 1.0 μsec/ft, impedance 1700 ohm, and insertion loss 0.3 db for a delay of 1.0 μsec. The operating temperature range is from −40° to +85°C. Diameter is 0.28 in. Calibrated lengths can be furnished with delays from a fraction of a microsecond to 100 μsec. (Columbia Technical Corp., Dept. S273)

■ GLASS DISPERSION in isopropyl alcohol is designed for use in coating metal which is to be heated. The glass forms a continuous film that inhibits oxidation and surface contamination. The dispersion is designed for use in forging of alloy steels, titanium, and other metals. (Acheson Colloids Co., Dept. S288)

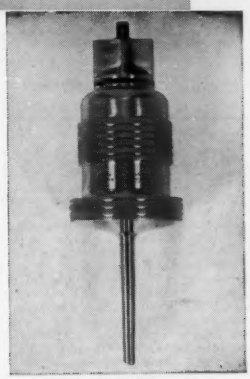
JOSHUA STERN
National Bureau of Standards

Reduce laboratory operating costs with —



NEW (K) STAINLESS STEEL VACUUM and PRESSURE FILTERS

▲ A-200 A-300



A-400

The simple design of these new precision-type filters makes it easy to disassemble and assemble them without tools. The filtering medium is a combination paper and asbestos pad of various grades to meet different filtration problems. Pad slips into pad housing quickly and a twirl of the threaded nut tightens it into position, the whole operation taking about a third as much time as in other similar filters. Although the vacuum filters have five components, they are so assembled that there are only two units to take apart for sterilization.

The Filters are made of Type 304 stainless steel to prevent deterioration. There are three laboratory models for small scale sterile filtration or pilot plant work.

Catalog No.	Model	Type	Liquid Capacity	Each (Without Pads)
F-2110X	A-200 (35 mm.)	Vacuum	40 cc.	$24.50
F-2111X	A-300 (50 mm.)	Vacuum	110 cc.	28.50
F-2112X	A-400 (65 mm.)	Pressure/Vacuum	120 cc.	36.50

Write for complete information which includes Flow Rate Data and Filter Pad Prices

SCIENTIFIC GLASS APPARATUS CO., INC.
BLOOMFIELD · NEW JERSEY
LABORATORY APPARATUS · INSTRUMENTS · CHEMICALS · GLASSWARE

PERSONNEL PLACEMENT

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

COPY for classified ads must reach SCIENCE 2 weeks before date of issue (Friday of every week).

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis — provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

Replies to blind ads should be addressed as follows:
Box (give number)
Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

POSITIONS WANTED

Bacteriologist–Virologist, Ph.D., 29; Canadian, desires to move to United States with family; 8 years of varied academic–industrial experience, chiefly veterinary microbiology and biologics; 35 publications. Desires industrial or academic position with opportunity for research. Box 135, SCIENCE. 5/3

Clinical Chemist; Ph.D., certified; 25 years' experience, including excellent academic affiliations; during past 2 years, director chemistry department, 400–bed hospital; $10,000; prefers West Coast; highly recommended. Woodward Medical Bureau, 185 N. Wabash, Chicago. X

Medical Writer, B.S. Background chemical and biological sciences; 9 years' experience pharmaceutical industry in preparation of literature surveys, technical brochures. Location New York City. Box 131, SCIENCE. X

Pharmacologist; 8 years, professor and head of pharmacognosy department, state university; 4 years, director of research, pharmaceutical company. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

Physiologist–Endocrinologist. M.S., male, 29; have equivalent Ph.D. training, including 2 years of medical school. Experienced in teaching and research; publications; member, Sigma Xi. Desire research position and/or teaching. Box 129, SCIENCE. 5/3

Ph.D., 32, endocrine physiology. Publications. Presently assistant professor endocrinology and general physiology. Desires relocate. Academic or industrial. Box 130, SCIENCE. X

Science Education, Harvard M.A., 40; 14 years' experience in high-school teaching (chemistry, physics, biology, and general science) case method; 8 years' concurrent protein chemistry research experience; publications; languages, French and Russian. Wants challenging position New York City area; field–science education; for example, foundation, museum, textbook editing, chemical industry liaison. Minimum salary, $6000. Box 132, SCIENCE. X

POSITIONS OPEN

Biochemist, Ph.D. to supervise clinical chemistry section of laboratory in 550-bed county hospital, metropolitan Detroit. About 55,000 chemical tests in 1956; about one-third of time for development of methods and one-third of time for original investigation. Salary $6723, annual increases $240; 40-hour week. Civil Service benefits, pension, social security, 12 holidays, liberal vacation, sick allowance, group hospitalization, and life insurance. Send photograph, résumé of training and experience, and references to Dr. S. E. Gould, Director of Laboratories, Wayne County General Hospital, Eloise, Michigan. 4/19, 26; 5/3

Biophysicist, Ph.D. preferred, for fundamental research in cardiac electrophysiology. University of Tennessee. Write Dr. Daniel A. Brody, 858 Madison Ave., Memphis 3, Tennessee. 5/3, 10, 17

POSITIONS OPEN

(a) Neurophysiologist or Physiological Psychologist interested in career in audition research; preferably Ph.D.; new laboratory; university affiliation; long-range research program; West. **(b) Bacteriologist, Chemist and Hematologist;** Ph.D. degrees or equivalent backgrounds required; key positions; old established hospital affiliated medical school; recently completed new hospital; East. **(c) Bacteriologist,** Ph.D., to direct manufacturing laboratories; various research programs; $5500–$8000; near Chicago. **(d) Physician** with comprehensive knowledge of medical advertising and pharmaceutical field; $18,000. **(e) Pharmaceutical Research Chemist;** preferably Ph.D.; new product department, large pharmaceutical company; university city, Midwest; $7500–$9000. S4-4 Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

PHYSIOLOGISTS
PHARMACOLOGISTS

Ph.D.'s in physiology, pharmacology, or biochemistry with orientation in cardiovascular and/or nutrition fields; or C.N.S. functions and clinical application of neuropharmacologic agents, to assist in evaluating new chemotherapeutic compounds for use in the treatment of mental illness.

ORGANIC CHEMISTS—
NATURAL PRODUCTS

M.S. degree or equivalent in organic chemistry with some botanical training and experience to evaluate scientific data in natural products research program.

ORGANIC CHEMISTS—
GENERAL

M.S. or equivalent in organic chemistry with strong background in biological science to collaborate in analyzing and evaluating experimental data in research program.

Applicants who desire to become associated with well-established, progressive eastern pharmaceutical laboratory with liberal benefit program should submit résumé with full information to

Box 140, SCIENCE

POSITIONS REQUIRING DEGREES IN MEDICINE OR SCIENCE: (a) Microbiologist; Ph.D. specialized virology, experimental immunology; inedical school research appointment; to $6500; Southeast central. **(b) Chemist;** B.S. or M.S. to head department, new 800-bed facility created by merger of three hospitals; $6000 up; university medical center; East. **(c) Physicians;** interested clinical research, pharmaceutical sales, or industrial pharmaceutical duties; salaries to $12,000; eastern pharmaceutical concern. **(d) Research Biochemist;** M.S., recent Ph.D.; research involves characterizing human proteins of serum; possible faculty appointment; to $6000; southern university medical school. **(e) Biochemist;** major project cardiovascular research, developing new research laboratory; to $12,000; Mideast. Woodward Medical Bureau, 185 N. Wabash, Chicago. X

SCIENCE TEACHERS, LIBRARIANS, ADMINISTRATORS urgently needed for September positions in many states and many foreign lands. No fees. Also unusual summer jobs and study awards. Rush $1 for complete job data, salaries. CRUSADE, SCI, Box 99, Station G, Brooklyn 22, N.Y. EOW

Technician. Electronic–mechanical to assist heart physiology research project, $4000–$4500. Physics or biology degree helpful. Small modern medical physics laboratory in Montana. Box 127, SCIENCE. 4/26; 5/3, 10

Teaching Position in Botany. Open September 1957. Rank and salary dependent on qualifications and experience. Write Chairman, Department of Biology, College of St. Thomas, St. Paul 1, Minnesota. 4/26; 5/3

The Market Place

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . . SCIENTIFIC PERIODICALS and BOOKS
Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.
WALTER J. JOHNSON, INC.
111 Fifth Avenue, New York 3, New York

Tables for the Variational Determination of ATOMIC WAVE FUNCTIONS by Philip M. Morse and Huseyin Yilmaz, 10 x 12, 86 pp. pamphlet bound $2.50
Technology Press of M.I.T.
Cambridge 39, Mass.

Your sets and files of scientific journals
are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, Inc. Boston 19, Massachusetts

The Identification of Crystalline Compounds
A detailed description of the technique for rapid identification of organic and inorganic crystals by means of the polarizing microscope is given in TECHNICS OF PLANT HISTOCHEMISTRY AND VIROLOGY, by T. E. Rawlins and Wm. N. Takahashi, University of California, Berkeley.
Price $3.50. Order from
The National Press, 435 Alma St., Palo Alto, Calif.

SCIENTIFIC JOURNALS WANTED
Sets, Runs and Volumes bought at top prices. Your wants supplied from our Back Files of over 3,000,000 periodicals. **Abrahams Magazine Service: N. Y. 3, N. Y.**

SUPPLIES AND EQUIPMENT

ANIMAL CAGES and ACCESSORY EQUIPMENT
BUY DIRECT FROM MANUFACTURER
SHIPMENT OF STANDARD ITEMS FROM STOCK
HOELTGE BROS., Inc.
1919 Gest St. Cincinnati 4, Ohio
Write for Illustrated Catalog
SERVICE SINCE 1856

PROFESSIONAL SERVICES

LaWall & Harrisson
Div. S, 1821 Walnut St., Philadelphia 3, Pa.
SINCE 1870
Food & Drug PROBLEMS
Pharmacological BACTERIOLOGICAL CHEMICAL

TO AUTHORS
seeking a publisher

Learn how we can publish, promote and distribute your book on a professional, dignified basis. All subjects considered. Scholarly and scientific works a specialty. Many successes, one a best seller. Write for booklet SC—it's free.
VANTAGE PRESS Inc. ● 120 W. 31 St., N.Y. 1
In Calif.: 6253 Hollywood Blvd., Hollywood 28
In Wash., D.C.: 1010 Vermont Ave., NW

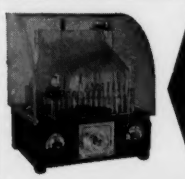
SUPPLIES AND EQUIPMENT

albino rats *
Hypophysectomized Rats
*Descendants of the Sprague-Dawley and Wistar Strains

"From the hand of the veterinarian to research"

HENRY L. FOSTER, D.V.M.
President and Director
THE CHARLES RIVER BREEDING LABS.
Dept. B, Wilmington, Mass.

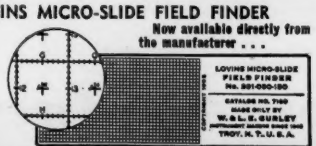
PROPERDIN
STANDARDIZED ASSAY REAGENTS
RP R3
ZYMOSAN
IMMUNOLOGICAL SPECIALTIES, Inc.
Box 24572 Los Angeles 24, Calif.



ULTRAMICRO
CONTINUOUS FLOW
KARLER KIRK
ELECTROCHROMATOGRAPHY
KARLER-KIRK UNIT
....WRITE FOR DATA →
MICROCHEMICAL SPECIALTIES CO.

ALBINO RATS
Our mass production methods insure greatest uniformity and consistency
Price list on request
DAN ROLFSMEYER CO. ■ Ph. 6-6149
Route 3, Syene Road, Madison, Wisconsin

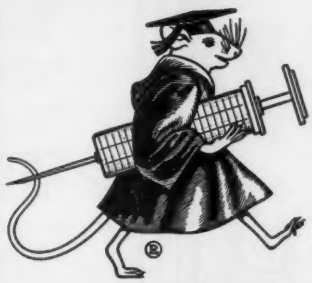
LOVINS MICRO-SLIDE FIELD FINDER
Now available directly from the manufacturer . . .



Write for details. W. & L. E. Gurley, Troy, N. Y.

SUPPLIES AND EQUIPMENT

SWISS MICE



TACONIC FARMS
GERMANTOWN NEW YORK
GERMANTOWN 3535
Send for booklet

MEVALONIC ACID C^{14}
and other tagged compounds OF HIGH RADIOPURITY
ISOTOPES SPECIALTIES COMPANY INC.
703 S. Main St. Burbank, Calif.

HOLTZMAN COMPANY
. . . continuous group uniformity
Rte. 4, Box 205 Madison, Wis.
Phone ALpine 6-5573

SWISS MICE
BACTERIOLOGICAL AND GROSS TISSUE STUDY TECHNIQUES USED IN OUR QUALITY CONTROL
HUNTINGDON FARMS, INC.
2548 NORTH 27th ST. PHILA. 32, PA.

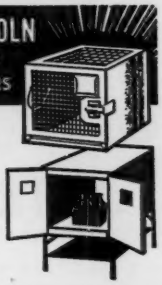
SUPPLIES AND EQUIPMENT

SPRAGUE-DAWLEY, INC.
PIONEERS IN THE DEVELOPMENT OF THE STANDARD LABORATORY RAT

OUR PLEDGE: Our insistence on the highest possible quality will never be sacrificed to quantity.

Sprague-Dawley, Inc.
P.O. Box 2071
Madison 5, Wisconsin
Phone: CEdar 3-5318

AMERICAN-LINCOLN
ANIMAL CAGES and INCUBATORS



● American-Lincoln animal cages of all types ranging from single units to large four compartment sizes. Special cages, spare pans, racks, etc., built to order. Incubators for egg embryo and container work used by America's leading scientific institutions.
Write for New Catalog
AMERICAN-LINCOLN INCUBATOR CO.
New Brunswick, N. J. Dept. AS

Rats from the Wistar Strain
Guinea Pigs **Laboratory Animals** Hamsters
since 1929
ALBINO FARMS, PO Box 331
RED BANK, NEW JERSEY
Swiss Mice — Albino Rabbits

GME
214 MARKET PLACE MADISON 3, WIS.
SEND FOR DETAILS ON THE NEW, ULTRA-COMPACT GME-LARDY WARBURG APPARATUS

STAINS—GURR'S—INDICATORS
FREE PRICE LIST
ESBE LABORATORY SUPPLIES
459 Bloor St., W. Toronto, Canada

7X®

Best Where A High Degree of Cleanliness is Required for Glassware!

NON - TOXIC for TISSUE CULTURE

- 7X is instantly and completely soluble in any concentration.
- It will not leave a film nor etch glassware (pH 7.2).
- 7X is not harmful to hands.
- Excellent for washing syringes.

Used by leading laboratories and is available from your laboratory supply dealer.

Write to Dept. S457 for information

LINBRO CHEMICAL CO.
681 DIXWELL AVE., NEW HAVEN 11, CONN.

AAAS SYMPOSIUM VOLUME

SOVIET SCIENCE

Second Printing

Russian Genetics	Theodosius Dobzhansky
Russian Physiology and Pathology	W. Horsley Gantt
Russian Psychology and Psychiatry	Ivan D. London
Scientific Method and Social Science: East and West	Russell L. Ackoff
Russian Contribution to Soil Science	J. S. Joffe
Soviet Physics and Chemistry	John Turkevich
Soviet Mathematics	J. R. Kline
Science and Intellectual Freedom in Russia	Lazar Volin
An Appraisal of Science in the USSR	Conway Zirkle

6 x 9 inches, clothbound, 115 pages, price $1.75

Prepaid orders by AAAS members, $1.50

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 Mass. Ave., NW, Washington 5, D.C.

SERVALL®

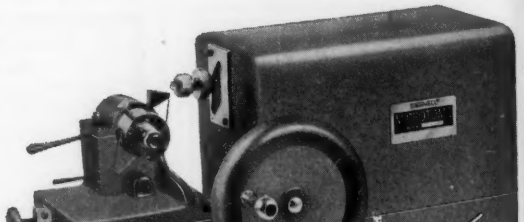
"Porter-Blum"

ULTRA-MICROTOME

1/40 MICRON (250A)

Recognized as the world's foremost Ultra-Microtome, the SERVALL "Porter-Blum" has become today's standard for research that requires uniform, ultra-thin sections. This sturdy, portable instrument enables even inexperienced operators to produce extended series of the highest quality for the electron microscope. Thick sections for light microscopy also may easily be obtained.

No special mountings are needed as the SERVALL "Porter-Blum" Ultra-Microtome is designed for use on laboratory bench or ordinary work surfaces.



PATENTS PENDING

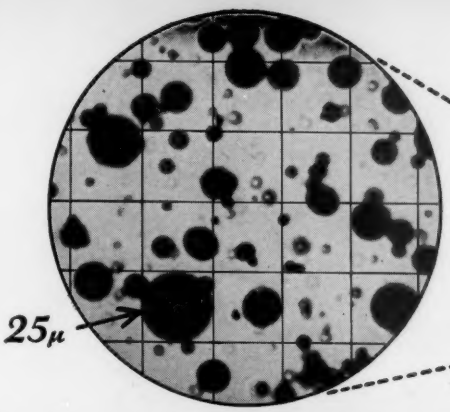
FEATURES

The new SERVALL "Porter-Blum" Ultra-Microtome incorporates: Improved and Relocated Tissue Thickness Selector • Cantilever Arm Lock for Paring and Orientating Specimen to Knife Edge • Microscope Pillar Support • Mechanical Advancement • Collet-Type Chuck • Safety "by-pass" Action to eliminate damage on return stroke • Versatile Adjustable Knife Holder • All Metal Hood.

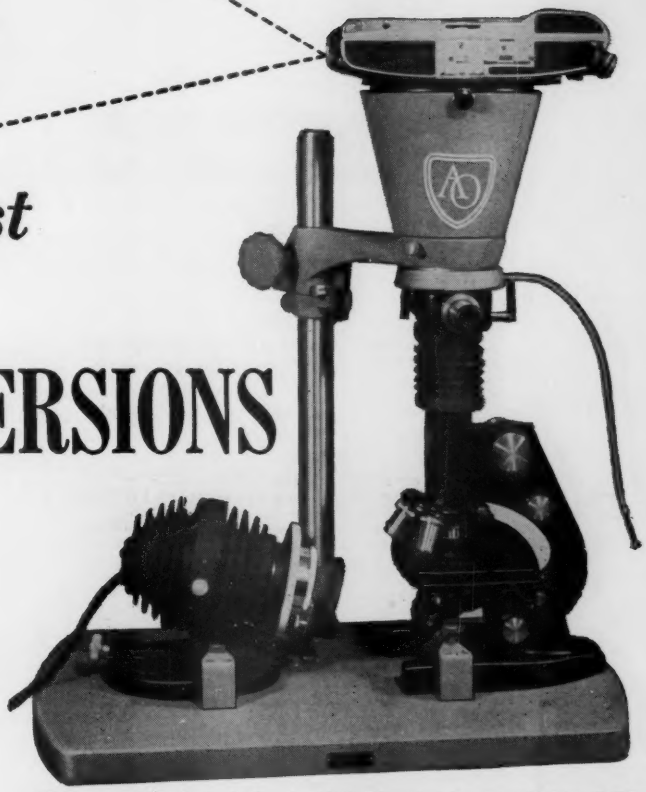
WRITE FOR BULLETIN SC-45

Ivan Sorvall, Inc.

NORWALK CONNECTICUT



Here's the *latest* on Lithium METAL DISPERSIONS



Microscope and Illuminator by American Optical Company, Instrument Division, Buffalo, New York. Polaroid® Land Camera by Polaroid Corporation, Cambridge, Massachusetts.

Got a catalyst problem?

Interest sparked by the discovery that lithium metal dispersions make unique polymerization catalysts (the polymerization of isoprene to a "natural" rubber) indicates a heretofore unexploited instrument of research.

Consequently, Lithium Corporation is now making available experimental quantities of dispersions of this highly reactive metal. These dispersions may be purchased in either mineral oil or a mineral oil-petrolatum combination as the dispersing medium. Dispersions in other media are available as special items. The "package" is obtainable in five sizes from 25 grams to 1 pound. Over 90% of the lithium metal particles have a diameter less than 25 microns.

Specifications, information for preparing the dispersions including handling instructions, prices and product data on lithium metal may be obtained by submitting a request on company or institutional stationery.

... trends ahead in industrial applications for lithium

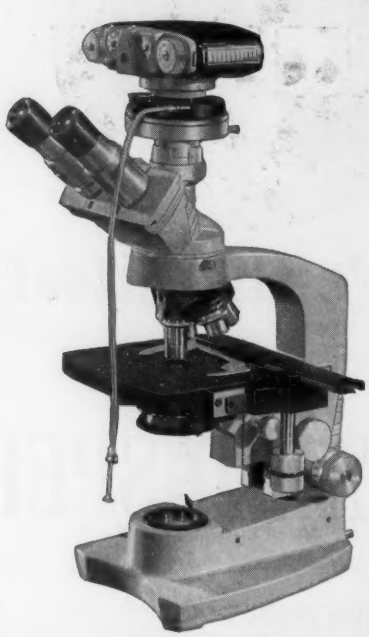
LITHIUM CORPORATION OF AMERICA, INC.
2699 RAND TOWER, MINNEAPOLIS 2, MINN.

PROCESSORS OF LITHIUM METAL • METAL DISPERSIONS
METAL DERIVATIVES: Amide • Hydride
SALTS: Bromide • Carbonate • Chloride • Hydroxide • Nitrate
SPECIAL COMPOUNDS: Aluminate • Borate • Borosilicate • Cobaltite • Manganite
Molybdate • Silicate • Titanate • Zirconate • Zirconium Silicate

BRANCH SALES OFFICES: New York • Chicago • Bessemer City, N. C.
MINES: Keystone, Custer, Hill City, South Dakota • Bessemer City, N. C.
Cat Lake, Manitoba • Amos Area, Quebec
PLANTS: St. Louis Park, Minnesota • Bessemer City, N. C.
RESEARCH LABORATORY: St. Louis Park, Minnesota

2 COMPLETELY **NEW** LINES

BY AMERICAN OPTICAL COMPANY



MICROSTAR

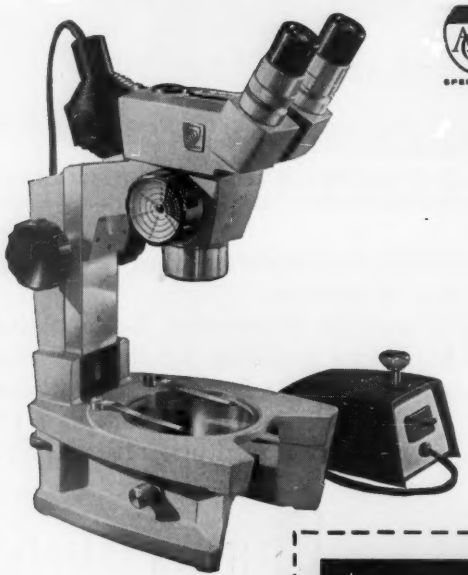
LABORATORY MICROSCOPES

Outstanding Features:

- Advanced styling and design
- Interchangeable and reversible bodies
- Rigid, well balanced arm
- Focusable stages . . . Variable autofocus
- Wide selection of mechanical stages
- Dual cone revolving nosepieces
- Zone of convenience
- Built-in base illuminator
- Top quality optics
- New EPOXY finish

Plus—

Wide variety of accessories and alternate parts . . . readily interchangeable to meet future needs.



CYCLOPTIC

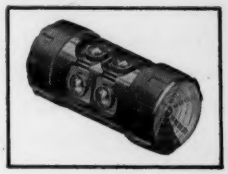
STEREOSCOPIC MICROSCOPES

Outstanding Features:

- True three-dimensional erected image
- Top quality optics . . . low reflection coated
- Reversible and inclined body
- Long working distance
- Large field of view
- Wide range of magnifications
- Broad selection of models
- Dove-gray EPOXY finish
- New Cyclospot Illuminator
- LOW PRICE

Plus—

Revolutionary MAGNI-CHANGER . . . desired magnifications simply "dialed in"!



American Optical Company

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK

Dept. P4

Gentlemen:

☐ Please rush new CYCLOPTIC brochure SB 56

☐ Please rush new MICROSTAR brochure SB 124

Name_____

Address_____

City_____ Zone____ State_____

DEFENSE PRODUCTS PLANT • KEENE, NEW HAMPSHIRE